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APPLICATION NUMBER: *60/519,410*
FILING DATE: *November 12, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/38636*

Certified by

Jon W Dudas

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EU851744985US

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Dennis	Coleman	Champaign, Illinois

Additional inventors are being named on the 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ Customer Number:

OR

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 27
☑ Drawing(s) *Number of Sheets* 19
☐ Application Date Sheet. See 37 CFR 1.76
☐ CD(s), Number
☑ Other (specify) Claims, 5 pages

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☑ Applicant claims small entity status. See 37 CFR 1.27.
☑ A check or money order is enclosed to cover the filing fees.
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FILING FEE Amount ($): 80.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.
☐ Yes, the name of the U.S. Government agency and the Government ~~contract~~ number are:

[Page 1 of 2]

Respectfully submitted,

SIGNATURE Michael L. Antoline

TYPED or PRINTED NAME Michael L. Antoline

TELEPHONE 217 352 4343

Date 11/12/03

REGISTRATION NO. 40,488 *(if appropriate)*

Docket Number:

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This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PROVISIONAL APPLICATION COVER SHEET
Additional Page

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Docket Number Pressurized Gas Samp

INVENTOR(S)/APPLICANT(S)		
Given Name (first and middle [if any])	Family or Surname	Residence (City and either State or Foreign Country)
Todd	Coleman	Champaign, Illinois

Number 1 of 1

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FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 80.00

Complete if Known	
Application Number	
Filing Date	11/12/03
First Named Inventor	Cikman
Examiner Name	
Art Unit	
Attorney Docket No.	Processing Gas Sampling Tube

METHOD OF PAYMENT *(check all that apply)*

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	80.00

SUBTOTAL (1) ($) 80.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

	Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X	=
Independent Claims		- 3** =		X	=
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($)

SUBMITTED BY				(Complete *(if applicable)*)	
Name (Print/Type)	Michael L. Antolino	Registration No. (Attorney/Agent)	40,488	Telephone	217 352 4343
Signature	Michael L. Antolino			Date	11/12/03

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	)	
	)	
DENNIS COLEMAN et. al.	)	Date: April 4, 2003
	)	
Serial No. Provisional	)	Group Art Unit:
	)	
Filed: 11/12/03	)	Examiner:
	)	
For: Pressurized gas sampling tube	)	Express Mail No. EU851744985US

EXPRESS MAIL CERTIFICATE

The enclosed documents include:

1. Provisional Application for Patent Cover Sheet in two pages for Coleman
2. Declaration for Utility Patent Application in two pages.
3. Fee Transmittal Sheet
4. My Firm's Number 1087 draft in the amount of $80.00.
5. Specification I, 11 pages.
6. Drawing set I, 8 pages.
7. Specification II, 14 pages.
8. Claims, 5 pages.
9. Drawing set II, 10 pages.
10. Specification III, 2 pages
11. Drawing Set III, 1 page.
12. Photographs, 10 on two sheets.
13. Self Addressed Return Receipt Postcard

Express Mail # EU 851744985 US **Date of Deposit: November 12, 2003**
I hereby certify that the above-named documents are being deposited with the United States Postal Service using "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Commissioner for Patents, Box PCT, United States Patent and Trademark Office, Washington, DC 20231."

Signed: _____
Michael L. Antoline, Reg. No. 40, 488

Spec + Drawings I

Sent to Tim Platt 11/12/02

Description

GAS SAMPLING APPARATUS

Technical Field

This apparatus relates to the collection, transportation and analysis of gas samples which may be required in various scientific, environmental and resource contexts. As an example, in oil and natural gas exploration, drilling, recovery and storage, periodic sampling of recovered gases and fluid are required for subsequent analysis. In the oil industry, "mud" is a colloquial term for a thick chemical composition that is pumped into drills as they penetrate the substrate. This "mud" is returned to the surface and contains gases that are released from the rock as the drill penetrates. Significant data is acquired from the analysis of these gases. As a further example, in the context of natural gas storage, large underground storage deposits are often chemically tagged for later identification. This apparatus facilitates the recovery of samples from these storage deposits for testing and identification of the chemical tag.

Background Art

United States Patent 5,116,330 to Spencer provided for a sample extraction system with a sampling container and valves. Such a sampling system requires the interruption of the fluid flow as sampling containers are exchanged. Further, extraction of the sample from the sampling container was accomplished by "bleeding" the cylinder, a technique which relies on gravity and is suitable for fluids in a liquid rather than a gaseous state. Currently used in the industry are gas sample bags, which have the obvious problems of fragility, occupying a significant volume when being shipped and the inability to contain gas or fluid under any significant pressure.

Disclosure of the Invention

The present invention provides a gas sampling apparatus in which continuous or periodic gas samples may be isolated in gas sampling containers. The gas sampling container associated with this apparatus contains self-sealing valves on either end which open when the sample container is positioned in the apparatus and automatically closes when the sampling container is removed from the apparatus. In one configuration, the

apparatus has two gas sampling tubes mounted and the gas flow which is to be sampled is directed into and out of one gas sampling container and then, by operating a valve system, the flow to be sampled can then be directed through a second sample container. Upon removal from the apparatus, the first sample container self-seals and may be transported. An empty container can then take its place. When the valve system again is actuated, the gas flow is re-directed from one sample container to the other. In this way, continuous sampling of a gas flow may be achieved. Further, mechanisms are provided that facilitate the pressurization and removal of gas samples from the sample containers.

Brief Description of the Drawings

Figure 1 is a front elevation view of the major components of the apparatus. Figure 2 is a cross sectional diagram of the flow of gas or fluid through the left half of the system.

Figure 3 is a cross sectional view of the gas flow through the right half of the system.

Figure 4 is a cross sectional view of the sample extraction assembly.

Figure 5 is a cross sectional view of a self-sealing chuck.

Figure 6 is a cross sectional view of a fixed chuck.

Figure 7 is a plan view of the top of the fixed chuck.

Figure 8 is a cross sectional view of the sampling container.

Figure 9 is a perspective view of the sample container ends.

Figure 10 is a cross sectional view of the spring-loaded chuck with the sample container seated therein.

Figure 11 is a perspective view of the apparatus.

Figure 12 is a cross sectional view of the plunger-activated valve.

Figure 13 is a cross sectional view of an alternative embodiment of a sample container.

Figure 14 is a cross sectional view of an extension rod pressurizer.

Figure 15 is a cross sectional view of the first end cap valve body.

Figure 16 is a view of an alternative mechanism assuaging the ends of the sampling container.

Best Mode for Carrying Out the Invention

Fig.1. illustrates the major components of the gas sampling apparatus. The gas sampling apparatus is given structure by its frame 1. The frame is composed of a rigid

substance, usually metal, and exhibits a longitudinal planer segment 40. The frame is further composed of a first planer segment end 41 and a second planer segment end 42. A first panel 43 emanates from the first planer segment end 41 and is oriented at right angles to the planer segment 40. The first panel 43 exhibits a plurality of apertures 44. A second panel 45 emanates from the second planer segment end 42 again at right angles to the planer segment 40. The second panel 45 also exhibits a plurality of apertures 46, in this case three in number, that correspond to and are opposite the apertures 44, exhibited by the first panel 43. Mounted to first panel 43 and through the outermost apertures of first panel 43 are fixed chucks 4 and 13. Mounted to second panel 45 and within the outermost apertures 46 are spring-loaded chucks 6 and 11.

Spring-loaded chuck 6 and spring-loaded chuck 11 as well as fixed chuck 4 and fixed chuck 13 provide the mounting means for first sample container 5 and the substantially similar second sample container 12. Turning for a moment to Figure 8, it is seen that the first sample container 5 is composed of an annular chamber 72 exhibiting second annular chamber end 73 and first annular chamber end 74. Figure 9 shows that first annular chamber end 74 exhibits first swaged edge 106 with two opposite notches 107. Turning to Fig. 16, an alternative means of swaging the edge is seen. Here the edge is swaged in a plurality of small increments or dimples (121) around the edge diameter. This can facilitate the insertion of other forms of end cap valves. Turning now to Fig. 8, the swaged edge 106 of first sample container 5 is shown disposed within the ~~central bore~~ first end cap 75. Disposed through both first annular chamber end 74 and first end cap central aperture 109 is first end cap valve assembly 76.

Turning now to Fig. 15, one of the components of the first end cap valve assembly 76, the first end cap valve body 77 is illustrated. It is composed of a transverse base 78 and annular section 79. Annular section 79 exhibits first annular section end 80 and second externally threaded annular section end 81, which is attached to the transverse base 78. Central bore 110 extends through both transverse base 78 and the annular section 79. The first annular section end 80 exhibits both external threads and internal threads within the central bore 110. The central bore 110 exhibits a conical narrowing, the central bore valve seat ~~section~~ 82. It is here that a plunger-activated valve 85 is seated. Turning now to Fig. 12 plunger activated valve 85 is shown. Plunger activated valve 85 is composed of a valve body 86 having a central cavity 90. Externally threaded first plunger valve body end 91 has a central bore 92 and a plurality of apertures 93 that communicate with the central cavity 90. The second plunger valve body end 94 also exhibits a corresponding central bore 95 with an annular space also communicating with the central cavity 90. The exterior of the valve body 86 exhibits a conical plunger valve body segment 105. A plunger valve body gasket 114 is seated around the conical plunger valve body segment 105 and substantially corresponds to the shape of the central bore valve seat section 82 shown in Fig. 15. Within the central cavity 90 are a first plunger rod support 96 having a central bore 97 and a plurality of apertures 98. The first plunger rod support is fixed to the interior walls of the central cavity 90. A second plunger rod support 99 also has a central bore 100 and a plurality of apertures 101. The second plunger rod support 99 is also fixed to the interior walls of the central cavity 90. Thus the central bores of the second plunger valve body end 94, the second plunger rod support 99, the first plunger rod support 96 and the first plunger valve body end 91 all correspond such that plunger 87 can be disposed

through all. Plunger 87 has a first plunger end 103 disposed outside central cavity 90 through central bore 92 and above valve body 86. A second plunger end 104 is also disposed outside the central cavity 90 through central bore 95 and below valve body 86. Plunger 87 also exhibits spring stop 115 fixed to plunger 87 between first plunger rod support 96 and second plunger rod support 99 but at a point on plunger 87 where the spring stop 115 communicates with the interior surface of the first plunger rod support 96 when in a resting position. The resting position is maintained by the tension of spring 89 disposed over the plunger rod and communicating with spring stop 115 and the second plunger rod support 99. Fixed to the second plunger valve body end 94 in such a manner as to preclude leakage around the plunger 87 is plunger gasket 88. Plunger gasket 88 in combination with second plunger end lip 104A seals the central bore 95 ~~and annular space 102~~ of second plunger valve body end 94 by being held against the plunger gasket 88 and the second plunger valve body end 94 by the pressure exerted by spring 89 on spring stop 115. transmitted to second plunger end lip 104A held tightly against plunger gasket 88.

Now returning to Fig. 15, it can be seen that when second plunger valve body end 94 of plunger activated valve 85 is inserted into first annular section end 80 of first end cap valve body 77, externally threaded first plunger valve body end 91 may be disposed within the internal threads of first annular section end 80. Disposition of plunger activated valve 85 is to such a depth as to press plunger valve body gasket 114 firmly against central bore valve seat section 82 creating a seal.

Turning again to Fig 8, it is seen that an annular rubber ring 111 is disposed over the annular section 79 and seats on the transverse base 78. Washer 112 is likewise disposed over the annular section 79 and seats on the annular rubber ring 111. Nut 113 is

then threaded down over the second externally threaded annular section end 81. Insertion of the components of the first end cap valve stem assembly is facilitated by notches 107. Once the first end cap valve assembly 76 is within the first annular chamber 72, nut 113 is tightened thereby applying pressure to washer 112 which in turn applies pressure to and expands the annular rubber ring 111 such that full diameter contact with the walls of the first annular chamber 72 and a tight seal is achieved. The first end cap 75 is then disposed over the first annular chamber end 74. Nut 113A is then disposed over annular section 79 and then threaded over second annular section end 81 until the nut communicates with the end cap exterior 108. The first end cap valve assembly 76 is then drawn toward the first swaged edge 106, which now retains the end cap valve assembly within first annular chamber 72 and holds the end cap in place. The second end cap 83 and second end cap valve assembly are similarly mounted within the second annular chamber end 73.

Now turning to Fig. 6, first fixed chuck 4 is illustrated. First fixed chuck 4 is composed of an annular body 61 with externally threaded end 63 and internally threaded end 62. A central bore exists between them. A first central bore section 64 is seen followed by larger diameter second central bore section 65. The differences in diameters produce seat 66. Upon seat 66 rests plunger depressor 67. Plunger depressor 67 has two components, a first finger member 68 and a first transverse member 69. The first transverse member is that portion of the plunger depressor 67, which communicates with the seat 66. A first flexible washer 71 is disposed over the first finger member 68 such that it rests on washer seat 63A of externally threaded end 63. However, as show in Fig. 7, the first transverse member 69 is not a disk but is rectangular in shape. When a first annular section end 80 of a first end cap valve assembly 76 is inserted in the retaining cap central

bore 116. it makes contact and seals against first flexible washer 71 and further depresses first flexible washer 71 into contact with first transverse member 69. The diameter of washer aperture 71 is less than the longitudinal length of the first transverse member, but greater than the width of the first transverse member such that only a portion of first flexible washer 71 is in contact with first transverse member 69 thus allowing fluid or gas to flow through first flexible washer 71, past first transverse member 69 into air passage aperture 70 and then into first central bore section 64 and beyond. A first plunger depressor retaining cap 116 is disposed over the externally threaded end 63. It holds washer 71 in position and thereby retains plunger depressor 67. The second fixed chuck is configured substantially similar to the first fixed chuck.

Configured similarly to the fixed chuck is the chuck head 117 of the first and second spring loaded chucks as showed in Fig. 10. Disposed within the internally threaded end 117A of chuck head 117 is pipe 118. Pipe 118 then extends through bushing 121 and is attached to ~~a flexible~~ connector 7A. which is of such a diameter as to prevent pipe 118 from being returned through bushing 121. Connector 7A is in turn connected to flexible tubing 7. Bushing 121 is fixed within an outer aperture 46 of panel 45. Spring 118A is disposed over pipe 118 and rests between chuck head 117 and bushing 121. When chuck head 117 is depressed, pipe 118 slides downward through bushing 121. As chuck head 117 is depressed, the tension in spring 118A is increased allowing chuck head 117 to return upward after pressure is released. The second spring loaded chuck is configured in a substantially similar fashion being mounted in the second outermost aperture of panel 45.

It can be envisioned in Fig. 1 that to insert a sample container, for example, sample container 5, the second end cap valve assembly 84 is disposed within the mouth 116A of

inlet 55. Second spring loaded chuck 11 is further connected to second valve right inlet 56. Mounted to communicate and to read pressure from second valve outlet 54 is second pressure gauge 151. Since first spring loaded chuck pipe 118 may be pressed through first spring loaded chuck bushing 121, the first spring loaded chuck 6 is connected to second valve left inlet 55 by means of flexible tubing 7. Similarly, second spring loaded chuck 11 is connected to second valve right inlet 56 by means of flexible tubing 7A. Valve control handle 9 extends through the central apertures 46 and 44 in first panel 43 and second panel 45 respectively. Control handle 9 communicates and simultaneously operates with first three-way valve 2 and second three-way valve 8.

Now turning to Fig. 2, we first see that control handle 9 is oriented toward first sample container 5. Control handle 9 exhibits first control handle end 9A and second control handle end 9B. First control handle end 9A is attached to and operates a first valve flow directing means 50 which is mounted internally in first three-way valve 2. The first valve flow directing means 50 exhibits a passage 51 with a first passage end 52 and a second passage end 53. When the control handle 9 is oriented toward sample container 5, first passage end 52 aligns with first valve inlet 47. Simultaneously, the second passage end 53 aligns with first valve left outlet 48. It can then be seen that gas may flow into the first valve inlet 47 through first valve flow directing means passage 51, out first valve left outlet 48, then through first fixed chuck 4 into sample container 5. Control handle second end 9B is similarly connected to second valve flow directing means 57. The second valve flow directing means exhibits conduit 58 which provides the same function as passage 51 in first valve flow directing means 50. Conduit 58 exhibits a first conduit end 59 and second conduit end 60. Control handle 9 is attached to both the first valve flow directing

valve assembly 76 thus creating a seal for gas or fluid. Returning to the description of the central bore we now have a second larger diameter segment (24) above or toward the externally threaded first body end (16). The difference in diameter between the small diameter segment (19) and a second larger diameter segment (24) creates a third lip (25). ~~Upon this third lip (25) rests first seal (28).~~ Disposed within the second larger diameter segment (24) and resting on the third lip (25) is first seal (28) again seen usually in the form of a rubber o-ring. Annular bushing (26) exhibiting a central bore communicates with the walls of the second larger diameter segment (24) and is coterminous with the externally threaded first body end (16). An internally threaded bushing retaining cap (27) having a central bore, is disposed over the externally threaded first body end (16).

The sample release device (30) exhibits stem (31) which is partially disposed within the central bore (18) of busing retaining cap (27), the central bore of the annular busing (26) and the small diameter segment (19) and may slide within. First seal (28) communicates with stem (31) thereby preventing the passage of fluid or gas around the stem. Stem (31) has a first stem end (32) and an internally threaded second stem end (33). Mounted within the internally threaded second stem end (33) is externally threaded stem retaining screw (37) having a threaded portion (38) and a cap portion (39). The cap portion (39) is of a larger diameter than stem (31) and thereby is able to rest on first lip (21). The stem retaining screw (37) thus secures stem (31) within body (15A). The stem retaining screw (37) also exhibits a central bore that communicates with the central bore of stem (31). First stem end (32) is attached to externally threaded septum seat (35). Septum (34) rests on said septum seat (35) and is composed of a penetrable material such as rubber. Septum (34) is held in place by internally threaded septum retaining cap (36). A

spring 35A is located between the septum seat (35) and internally threaded bushing retaining cap (27) which is disposed over externally threaded first body end (16).

After the sample extraction assembly (14) is threaded~~ly attached to~~ on to an end cap valve assembly, such as first end cap valve assembly 76, a needle such as a hypodermic needle, is inserted through the central conical aperture (36A) of the septum retaining cap (36). Depressing the sample release device (30) compresses spring (35A). In turn, stem (31) and stem retaining screw (37) are depressed such that stem retaining screw makes contact with plunger 103 shown in Fig. 12 thereby opening the sample container, such as sample container 5. When this is accomplished the sample may be extracted from the container.

Prior to removing a sample from the sample container, it may be necessary to pressurize the sample. This may be accomplished by removing the cap retaining nut such as retaining nut (113A) in Fig. 8. ~~and then threadedly mounting~~ Turning now to Fig. 14 it can be seen that extension rod pressurizer 117 may be threaded on to an end cap valve assembly such as first end cap valve assembly (76). By using the extension rod pressurizer 117 to press first end cap valve assembly (76) further into the sample container, increased pressure of the sample may be obtained. Extension rod pressurizer (117) is composed of an internally threaded tube (118) which is disposed over the externally threaded end of the first end cap valve assembly (76). Bolt (119) is threaded into internally threaded tube (118) and held by lock nut (120). The length of the extension rod pressurizer may be adjusted by loosening the lock nut (120) and threading bolt (118) farther into or out of threaded tube (118). The adjustability of extension rod pressurizer 117 allows it to be inserted farther into the sample tube, thus, increasing pressurization of the sample.

Another form of sample container is illustrated in Fig. 13. Sample container ~~(130)~~ has internally threaded ends ~~(131)~~ and ~~(132)~~. ~~An e~~Externally threaded end valves ~~(133)~~ and 133A with the same internal mechanism of first end cap valve assembly ~~(76)~~ may then be inserted creating a sample container.

An alternative ~~mode of~~ configuration for the fixed chuck and chuck heads of the spring loaded chuck is seen in Fig. 5. Here, the plunger depressor 123 in addition to a finger member 124 and a transverse member 125, has a stem member 126. Spring 127 rests between seat 128 and transverse member 125. The tension in spring 127 creates a seal between transverse member 125 and seal 129. This configuration allows any fluid or gas trapped in central bore 130 to remain captured. This is especially important when noxious gas for fluid is being sampled with this system.

Industrial Applicability

As stated earlier, this gas sampling apparatus has applicability to the oil and gas industry. However, it can also find use in any industry in which the continuous sampling of flows of gases or fluids are required. Further, the assembly also has applicability in any industry in which gas samples need to be transported in either a pressurized or unpressurized state and later need to be easily removed for testing.

Spec. + Drawings II

Description

GAS SAMPLING APPARATUS

Technical Field

This apparatus relates to the collection, transportation and analysis of gas samples which may be required in various scientific, environmental and resource contexts. As an example, in oil and natural gas exploration, drilling, recovery and storage, periodic sampling of recovered gases and fluid are required for subsequent analysis. In the oil industry, "mud" is a colloquial term for a thick chemical composition that is pumped into drills as they penetrate the substrate. This "mud" is returned to the surface and contains gases that are released from the rock as the drill penetrates. Significant data is acquired from the analysis of these gases. As a further example, in the context of natural gas storage, large underground storage deposits are often chemically tagged for later identification. This apparatus facilitates the recovery of samples from these storage deposits for testing and identification of the chemical tag.

Background Art

United States Patent 5,116,330 to Spencer provided for a sample extraction system with a sampling container and valves. Such a sampling system requires the interruption of the fluid flow as sampling containers are exchanged. Further, extraction of the sample from the sampling container was accomplished by "bleeding" the cylinder, a technique which relies on gravity and is suitable for fluids in a liquid rather than a gaseous state. Currently used in the industry are gas sample bags, which have the obvious problems of fragility, occupying a significant volume when being shipped and the inability to contain gas or fluid under any significant pressure.

Disclosure of the Invention

The present invention provides a gas sampling apparatus in which continuous or periodic gas samples may be isolated in gas sampling containers. The gas sampling container associated with this apparatus contains self-sealing valves on either end which open when the sample container is positioned in the apparatus and automatically closes when the sampling container is removed from the apparatus. In one configuration, the

apparatus has two gas sampling tubes mounted and the gas flow which is to be sampled is directed into and out of one gas sampling container and then, by operating a valve system, the flow to be sampled can then be directed through a second sample container. Upon removal from the apparatus, the first sample container self-seals and may be transported. An empty container can then take its place. When the valve system again is actuated, the gas flow is re-directed from one sample container to the other. In this way, continuous sampling of a gas flow may be achieved. Further, mechanisms are provided that facilitate the pressurization and removal of gas samples from the sample containers.

Brief Description of the Drawings

Figure 1 is a front elevation view of the major components of the apparatus. Figure 2 is a cross sectional diagram of the flow of gas or fluid through the left half of the system.

Figure 3 is a cross sectional view of the gas flow through the right half of the system.

Figure 4 is a cross sectional view of the sample extraction assembly.

Figure 5 is a cross sectional view of a self-sealing chuck.

Figure 6 is a cross sectional view of a fixed chuck.

Figure 7 is a plan view of the top of the fixed chuck.

Figure 8 is a cross sectional view of the sampling container.

Figure 9 is a perspective view of the sample container ends.

Figure 10 is a cross sectional view of the spring-loaded chuck with the sample container seated therein.

Figure 11 is a perspective view of the apparatus.

Figure 12 is a cross sectional view of the plunger-activated valve.

Figure 13 is a cross sectional view of an alternative embodiment of a sample container.

Figure 14 is a cross sectional view of an extension rod pressurizer.

Figure 15 is a cross sectional view of the first end cap valve body.

Figure 16 is a view of an alternative mechanism assuaging the ends of the sampling container.

Best Mode for Carrying Out the Invention

Fig.1. illustrates the major components of the gas sampling apparatus. The gas sampling apparatus is given structure by its frame 1. The frame is composed of a rigid

substance, usually metal, and exhibits a longitudinal planer segment 40. The frame is further composed of a first planer segment end 41 and a second planer segment end 42. A first panel 43 emanates from the first planer segment end 41 and is oriented at right angles to the planer segment 40. The first panel 43 exhibits a plurality of apertures 44. A second panel 45 emanates from the second planer segment end 42 again at right angles to the planer segment 40. The second panel 45 also exhibits a plurality of apertures 46, in this case three in number, that correspond to and are opposite the apertures 44, exhibited by the first panel 43. Mounted to first panel 43 and through the outermost apertures of first panel 43 are fixed chucks 4 and 13. Mounted to second panel 45 and within the outermost apertures 46 are spring-loaded chucks 6 and 11.

Spring-loaded chuck 6 and spring-loaded chuck 11 as well as fixed chuck 4 and fixed chuck 13 provide the mounting means for first sample container 5 and the substantially similar second sample container 12. Turning for a moment to Figure 8, it is seen that the first sample container 5 is composed of an annular chamber 72 exhibiting second annular chamber end 73 and first annular chamber end 74. Figure 9 shows that first chamber end 74 exhibits first swaged edge 106 with two opposite notches 107. Turning to Fig. 16, an alternative means of swaging the edge is seen. Here the edge is swaged in a plurality of small increments or dimples 121 around the edge diameter. This can facilitate the insertion of other forms of end cap valves. Turning now to Fig. 8, the swaged edge 106 of first sample container 5 is shown disposed within the central bore first end cap 75. Disposed through both first annular chamber end 74 and first end cap central aperture 109 is first end cap valve assembly 76.

Turning now to Fig. 15, one of the components of the first end cap valve assembly 76, the first end cap valve body 77 is illustrated. It is composed of a transverse base 78 and annular section 79. Annular section 79 exhibits first annular section end 80 and second externally threaded annular section end 81, which is attached to the transverse base 78. Central bore 110 extends through both transverse base 78 and the annular section 79. The first annular section end 80 exhibits both external threads and internal threads within the central bore 110. The central bore 110 exhibits a conical narrowing, the central bore valve seat 82. It is here that a plunger-activated valve 85 is seated. Turning now to Fig. 12 plunger activated valve 85 is shown. Plunger activated valve 85 is composed of a valve body 86 having a central cavity 90. Externally threaded first plunger valve body end 91 has a central bore 92 and a plurality of apertures 93 that communicate with the central cavity 90. The second plunger valve body end 94 also exhibits a corresponding central bore 95 with an annular space also communicating with the central cavity 90. The exterior of the valve body 86 exhibits a conical plunger valve body segment 105. A plunger valve body gasket 114 is seated around the conical plunger valve body segment 105 and substantially corresponds to the shape of the central bore valve seat section 82 shown in Fig. 15. Within the central cavity 90 are a first plunger rod support 96 having a central bore 97 and a plurality of apertures 98. The first plunger rod support is fixed to the interior walls of the central cavity 90. A second plunger rod support 99 also has a central bore 100 and a plurality of apertures 101. The second plunger rod support 99 is also fixed to the interior walls of the central cavity 90. Thus the central bores of the second plunger valve body end 94, the second plunger rod support 99, the first plunger rod support 96 and the first plunger valve body end 91 all correspond such that plunger 87 can be disposed

through all. Plunger 87 has a first plunger end 103 disposed outside central cavity 90 and above valve body 86. A second plunger end 104 is also disposed outside the central cavity 90 and below valve body 86. Plunger 87 also exhibits spring stop 115 fixed to plunger 87 between first plunger rod support 96 and second plunger rod support 99 but at a point on plunger 87 where the spring stop 115 communicates with the interior surface of the first plunger rod support 96 when in a resting position. The resting position is maintained by spring 89 disposed over the plunger rod and communicating with spring stop 115 and the second plunger rod support 99. Fixed to the second plunger valve body end 94 in such a manner as to preclude leakage around the plunger 87 is plunger gasket 88. Plunger gasket 88 seals the central bore 95 of second plunger valve body end 94 by being held against the second plunger valve body end 94 by the pressure exerted by spring 89 on spring stop 115

Now returning to Fig. 15, it can be seen that when second plunger valve body end 94 of plunger activated valve 85 is inserted into first annular section end 80 of first end cap valve body 77, externally threaded first plunger valve body end 91 may be disposed within the internal threads of first annular section end 80. Disposition of plunger activated valve 85 is to such a depth as to press plunger valve body gasket 114 firmly against central bore valve seat section 82 creating a seal.

Turning again to Fig 8, it is seen that an annular rubber ring 111 is disposed over the annular section 79 and seats on the transverse base 78. Washer 112 is likewise disposed over the annular section 79 and seats on the annular rubber ring 111. Nut 113 is then threaded down over the second externally threaded annular section end 81. Insertion of the components of the first end cap valve stem assembly is facilitated by notches 107.

Once the first end cap valve assembly 76 is within the first annular chamber 72, nut 113 is tightened thereby applying pressure to washer 112 which in turn applies pressure to and expands the annular rubber ring 111 such that full diameter contact with the walls of the first annular chamber 72 and a tight seal is achieved. The first end cap 75 is then disposed over the first annular chamber end 74. Nut 113A is then disposed over annular section 79 and then threaded over second annular section end 81 until the nut communicates with the end cap exterior 108. The first end cap valve assembly 76 is then drawn toward the first swaged edge 106, which now retains the end cap valve assembly within first annular chamber 72 and holds the end cap in place. The second end cap 83 and second end cap valve assembly are similarly mounted within the second annular chamber end 73.

Now turning to Fig. 6, first fixed chuck 4 is illustrated. First fixed chuck 4 is composed of an annular body 61 with externally threaded end 63 and internally threaded end 62. A central bore exists between them. A first central bore section 64 is seen followed by larger diameter second central bore section 65. The differences in diameters produce seat 66. Upon seat 66 rests plunger depressor 67. Plunger depressor 67 has two components, a first finger member 68 and a first transverse member 69. The first transverse member is that portion of the plunger depressor 67, which communicates with the seat 66. A first flexible washer 71 is disposed over the first finger member 68 such that it rests on washer seat 63A of externally threaded end 63. However, as show in Fig. 7, the first transverse member 69 is not a disk but is rectangular in shape such that only a portion of first flexible washer 71 is in contact with first transverse member 69 thus allowing fluid or gas to flow through first flexible washer 71, past first transverse member 69 into air passage aperture 70 and then into first central bore section 64 and beyond. A first plunger

depressor retaining cap 116 is disposed over the externally threaded end 63. It holds washer 71 in position and thereby retains plunger depressor 67. The second fixed chuck is configured substantially similar to the first fixed chuck.

Configured similarly to the fixed chuck is the chuck head 117 of the first and second spring loaded chucks as showed in Fig. 10. Disposed within the internally threaded end 117A of chuck head 117 is pipe 118. Pipe 118 then extends through bushing 121 and is attached to a flexible connector 7A, which is of such a diameter as to prevent pipe 118 from being returned through bushing 121. Bushing 121 is fixed within an outer aperture 46 of panel 45. Spring 118A is disposed over pipe 118 and rests between chuck head 117 and bushing 121. When chuck head 117 is depressed, pipe 118 slides downward through bushing 121. As chuck head 117 is depressed, the tension in spring 118A is increased allowing chuck head 117 to return upward after pressure is released. The second spring loaded chuck is configured in a substantially similar fashion being mounted in the second outermost aperture of panel 45.

It can be envisioned in Fig. 1 that to insert a sample container, for example, sample container 5, the second end cap valve assembly 84 is disposed within the mouth 116A of spring loaded chuck 6. Downward pressure is then applied whereupon spring loaded chuck 6 is pressed down and through spring loaded chuck bushing 121. Spring loaded chuck 6 is able to be depressed a sufficient distance to allow the upper end of sample container 5 to be positioned under fixed chuck 4. Downward pressure on the sample container is then released allowing the first end cap valve assembly 76 of sample container 5 to seat within fixed chuck 4. A similar procedure is utilized to mount the second sample container 12 between spring loaded chuck 11 and fixed chuck 13.

At this point, it is critical to note the insertion of the end cap valve assemblies into spring loaded chuck 6 and fixed chuck 4 causes the ends of the end cap valve assemblies to be pressed into to be pressed against the flexible washers such as the first flexible washer 71 illustrated in Fig. 10. This produces a seal. A first finger member such as first finger member 68 of plunger depressor 67, as seen in Fig. 6, will come in contact with a plunger such as plunger 87 of plunger activated valve 85, asseen in Fig. 12 causing the sample container, such as sample container 5 to open. This happens on both ends of the sample container allowing gas or fluid to pass through when the sample container if seated in the fixed and spring-loaded chucks.

Returning to Figure 1, first three-way valve 2 is mounted to panel 43 between first fixed chuck 4 and second fixed chuck 13. First fixed chuck 4 is connected to the first valve left outlet 48. The second fixed chuck 13 is connected to the first valve right outlet 49. Mounted so as to read pressure from the first valve inlet 47 is pressure gauge 150. A similar configuration is seen with the second three-way valve 8, which is similarly attached to second panel 45. The first spring loaded chuck 6 is connected to the second valve left inlet 55. Second spring loaded chuck 11 is further connected to second valve right inlet 56. Mounted to communicate and to read pressure from second valve outlet 54 is second pressure gauge 151. Since first spring loaded chuck pipe 118 may be pressed through first spring loaded chuck bushing 121, the first spring loaded chuck 6 is connected to second valve left inlet 55 by means of flexible tubing 7. Similarly, second spring loaded chuck 11 is connected to second valve right inlet 56 by means of flexible tubing 7A. Valve control handle 9 extends through the central apertures 46 and 44 in first panel 43 and second panel

45 respectively. Control handle 9 communicates and simultaneously operates with first three-way valve 2 and second three-way valve 8.

Now turning to Fig. 2, we first see that control handle 9 is oriented toward first sample container 5. Control handle 9 exhibits first control handle end 9A and second control handle end 9B. First control handle end 9A is attached to and operates a first valve flow directing means 50 which is mounted internally in first three-way valve 2. The first valve flow directing means 50 exhibits a passage 51 with a first passage end 52 and a second passage end 53. When the control handle 9 is oriented toward sample container 5, first passage end 52 aligns with first valve inlet 47. Simultaneously, the second passage end 53 aligns with first valve left outlet 48. It can then be seen that gas may flow into the first valve inlet 47 through first valve flow directing means passage 51, out first valve left outlet 48, then through first fixed chuck 4 into sample container 5. Control handle second end 9B is similarly connected to second valve flow directing means 57. The second valve flow directing means exhibits conduit 58 which provides the same function as passage 51 in first valve flow directing means 50. Conduit 58 exhibits a first conduit end 59 and second conduit end 60. Control handle 9 is attached to both the first valve flow directing means 50 and second valve flow directing means 57 such that when the first valve flow directing means 50 is oriented as described above, the second valve flow directing means 57 is oriented in such a way that first conduit end 59 communicates with second valve inlet 55 and second conduit end 60 communicates with second valve outlet 54. It can be seen that any gas or fluid in sample container 5 may then flow through second spring loaded chuck 6 through flexible tubing 7 into second valve left inlet 55 through the second valve flow directing means conduit 58 and finally out second valve outlet 54.

Now turning to Fig. 3, it can be seen that when handle 9 is directed toward second sample container 12, the first valve flow directing means 50 is oriented such that first passage end 52 communicates with first valve inlet 47 and second passage end 53 is now oriented with first valve right outlet 49. Now it can be seen that gas may flow in first valve inlet 47 through first valve flow directing means passage 51 into the first valve right outlet 49 through fixed chuck 13 and into second sample container 12.

Again, when handle 9 is oriented towards second sample container 12, the second valve flow directing means 57 has its conduit 58 oriented in such a way that first conduit end 59 communicates with second valve inlet 56 and second conduit end 60 communicates with second valve right outlet 54. Now it can be seen that fluid or gas in sample container 12 may flow through spring loaded chuck 11 then through flexible tubing 7A into second valve inlet 56 through passage 58 and into second valve outlet 54.

A method of acquiring samples would be to allow gas to flow through sample container 5 and then after having mounted sample container 12, orienting the control handle so that gas flow is terminated through sample container 5 and gas now flows through sample container 12. In this way, sample container 5 may be removed from the system and an empty sample container mounted. When sufficient sample has been gathered within sample container 12, the control handle 9 would then again be moved toward the fresh sample container thus occluding gas flow through sample container 12 whereupon it may be removed from the system. By alternating the removal of full sample containers and the replacement with empty containers, continuous or periodic samples in a line of gas or fluid flow may be obtained.

Once the sample container is removed from the gas sampling apparatus the fluid or gas sample must be removed from the container. Fig. 4 illustrates the sample extraction assembly 14. It is composed of a coupler 15. The coupler 15 exhibits a coupler body 15A. The coupler body has a longitudinal bore 18A allowing for fluid flow. The coupler also has an externally threaded first coupler body end 16 and an internally threaded second coupler body end 17. The central bore is divided into segments of varying diameters. The narrowest diameter is the small diameter segment 19. Below, that is toward the internally threaded second coupler body end 17 is the first larger diameter segment 20. The differences in diameter allow the formation of first lip 21. Again below, toward the internally threaded second body end 17 is the first largest diameter segment 22. The differences in diameter again allow the formation of another lip, second lip 23. Upon second lip 23 rests a second seal 29 usually in the form of a rubber o-ring. This allows the internally threaded second body end to be disposed over the externally threaded portion of a first annular section end 80 of an end cap valve assembly such as first end cap valve assembly 76 thus creating a seal for gas or fluid. Returning to the description of the central bore we now have a second larger diameter segment 24 above or toward the externally threaded first body end 16. The difference in diameter between the small diameter segment 19 and a second larger diameter segment 24 creates a third lip 25. Disposed within the second larger diameter segment 24 and resting on the third lip 25 is first seal 28 again seen usually in the form of a rubber o-ring. Annular bushing 26 exhibiting a central bore communicates with the walls of the second larger diameter segment 24 and is coterminous with the externally threaded first body end 16. An internally threaded

bushing retaining cap 27 having a central bore, is disposed over the externally threaded first body end 16.

The sample release device 30 exhibits stem 31 which is partially disposed within the central bore 18 of busing retaining cap 27, the central bore of the annular busing 26 and the small diameter segment 19 and may slide within. First seal 28 communicates with stem 31 thereby preventing the passage of fluid or gas around the stem. Stem 31 has a first stem end 32 and an internally threaded second stem end 33. Mounted within the internally threaded second stem end 33 is externally threaded stem retaining screw 37having a threaded portion 38 and a cap portion 39. The cap portion 39 is of a larger diameter than stem 31 and thereby is able to rest on first lip 21. The stem retaining screw 37 thus secures stem 31 within body 15A. The stem retaining screw 37 also exhibits a central bore that communicates with the central bore of stem 31. First stem end 32 is attached to externally threaded septum seat 35. Septum 34 rests on said septum seat 35 and is composed of a penetrable material such as rubber. Septum 34 is held in place by internally threaded septum retaining cap 36. A spring 35A is located between the septum seat 35 and internally threaded bushing retaining cap 27 which is disposed over externally threaded first body end 16.

After the sample extraction assembly 14 is threaded on to an end cap valve assembly, such as first end cap valve assembly 76, a needle such as a hypodermic needle, is inserted through the central conical aperture 36A of the septum retaining cap 36. Depressing the sample release device 30 compresses spring 35A. In turn, stem 31 and stem retaining screw 37 are depressed such that stem retaining screw makes contact with

plunger 103 shown in Fig. 12 thereby opening the sample container, such as sample container 5. When this is accomplished the sample may be extracted from the container.

Prior to removing a sample from the sample container, it may be necessary to pressurize the sample. This may be accomplished by removing the cap retaining nut such as retaining nut 113A in Fig. 8. and then threadedly mounting extension rod pressurizer 117 to an end cap valve assembly such as first end cap valve assembly 76. By using the extension rod pressurizer 117 to press first end cap valve assembly 76 further into the sample container, increased pressure of the sample may be obtained. Extension rod pressurizer 117 is composed of an internally threaded tube 118 which is disposed over the externally threaded end of the first end cap valve assembly 76. Bolt 119 is threaded into internally threaded tube 118 and held by lock nut 120. The length of the extension rod pressurizer may be adjusted by loosening the lock nut 120 and threading bolt 118 farther into or out of threaded tube 118.

Another form of sample container is illustrated in Fig. 13. Sample container 130has internally threaded ends 131 and 132. Externally threaded end valves 133 and 133A with the same internal mechanism of first end cap valve assembly 76 may then be inserted creating a sample container.

An alternative configuration for the fixed chuck and chuck heads of the spring loaded chuck is seen in Fig. 5. Here, the plunger depressor 123 in addition to a finger member 124 and a transverse member 125, has a stem member 126. Spring 127 rests between seat 128 and transverse member 125. The tension in spring 127 creates a seal between transverse member 125 and seal 129. This configuration allows any fluid or gas

trapped in central bore 130 to remain captured. This is especially important when noxious gas for fluid is being sampled with this system.

Industrial Applicability

As stated earlier, this gas sampling apparatus has applicability to the oil and gas industry. However, it can also find use in any industry in which the continuous sampling of flows of gases or fluids are required. Further, the assembly also has applicability in any industry in which gas samples need to be transported in either a pressurized or unpressurized state and later need to be easily removed for testing.

Spec + Drawings III

This embodiment of the sample container will be usable at pressures potentially as high as several hundred pounds per square inch. There are several advantages of the pressurized container.

1. Compared to standard high-pressure compressed gas sampling cylinders, there will be a huge cost advantage. Standard D.O.T. approved reusable high-pressure gas sampling cylinders with valves and end caps are about $200 each. The recommended retail price of this embodiment of the sample container will be $25 each. This lower cost allows it to be used as a single use, non-refillable container with fewer shipping restrictions than with either reusable non-pressurized containers, or reusable D.O.T. approved high-pressure compressed gas cylinders.
2. Because this embodiment of the sample container qualifies as a single use, non-refillable container that is certified by the U.S. D.O.T. for shipping of compressed gases, shipping restrictions are greatly reduced. With the other embodiments of the container, in a standard size having a volume of about 120 cubic centimeters, a maximum of 8 per box could be shipped on passenger aircraft and up to 40 per box could be shipped on cargo-only aircraft (according to the regulations of the International Air Transport Association, IATA). This can be a significant problem in some situations because some areas of the world do not have cargo-only aircraft service. And because the projects for which these containers are used involve collection of as many as 200 to 300 samples, shipping in groups of 8 is very inefficient and expensive. Consequently, some samples are sent by ship which results in delivery times of several months. For non-compressed gases shipping quantities are given as volumes (1 liter per outer box for passenger aircraft, 5 liters for cargo-only aircraft). For compressed gases, quantity limitations are by net weight. Because these containers are to be used primarily for natural gas, which is mostly methane and generally lighter than air, if the volume of the containers is no more than 120 cubic centimeters each, the quantity that can be shipped in one outer package, even on passenger aircraft, is so large that it presents no practical limitation. Thus, 25, 50, or even 100 of these containers per box is perfectly legal.
3. Although the standard reusable D.O.T. approved high-pressure gas sampling cylinders containing flammable gases can be shipped on cargo-only aircraft, they too are prohibited on passenger aircraft.
4. The ability to ship pressurized samples will also simplify sample collection. The primary application for gas sampling containers of this type has been collection of mud gases from oil and gas well drilling operations. In some cases the sample must be drawn from a line that is pressurized to 25 or 30 psi. With non-pressurized sampling containers it is necessary to reduce the pressure in the container to atmospheric pressure before shipping. This has provides a complicating factor results in some samples actually being shipped illegally.
5. By compressing the gas, the amount of sample that can be collected is several times larger than with the, non-pressurized samples in comparable sized containers. For example, if the pressure is 150 psi, the amount of sample is actually 11 times as much as a non-compressed sample in the same size container. This larger sample size allows additional analyses to be carried out that could not be done with non-compressed samples.

Fig. Y is an alternative embodiment of the sample container as shown in Figure 9 of the attached specifications. Instead of having a cap disposed over an open-ended cylinder as shown in Fig. 9, Fig. Y shows a cross section of a cylinder (15) having a closed end (10), which is perforated by circular cylinder aperture (8). An elevation view of closed end (10) is seen in FIG. Z, which also exhibits circular aperture 8. Returning to Fig. Y it is seen that cylinder walls (16) extend toward an open cylinder end (19). The open cylinder end (19) exhibits a rolled lip (18) formed by cylinder wall (16) being formed inward then outward to such an extent that cylinder wall (16) touches itself at point (17) thus forming the rolled lip (18). Cap (20) is shown in Fig. Y and also in Fig. X. Cap (20) is cup shaped and of such a diameter that cap sides (19) communicate with rolled lips (18) yet allows cap bottom 22 to slide within cylinder (15) allowing partially rolled flange (26) to also communicate with rolled lip (18). Partially rolled flange is formed in such a way as to allow its inner curved surface (27) to communicate with outer curved surface (28) of rolled lip (18). Seal (25) is annular in shape and rests on the inner curved surface. When cap (20) is fully inserted into cylinder (15), partially rolled flange (26) communicates with seal (25) which, in turn, communicates with rolled lip (18) forming an air or gas tight seal. When partially rolled flange is then further rolled or crimped, the flange end, is pressed under rolled lip (18) at point (30). This tightly compresses seal (25) allowing cylinder (15) to be so tightly sealed as to allow cylinder (15) to contain compressed gasses or liquids. Cylinder (15) will be composed of aluminum, steel or other substance of suitable strength for compressed gasses and liquids. Circular cap aperture (24) is substantially the same diameter as circular cylinder aperture (8). Valve body (2) is inserted through circular cylinder aperture (8) such that valve body first end (4) is exterior to cylinder (15) and valve body second end (6) is interior. Valve body lip (14) causes valve body second end (6) to be retained with cylinder (15) and also allows the compression of seal (12) between valve body lip (14) and cylinder end (10). Valve body is substantially similar to Fig. 15 in the drawing accompanying the full specification and it can be seen that valve body (2) is externally threaded. Valve body (2) will accept washer (3) over valve body first end (4) and will also accept internally threaded nut (5) such that when internally threaded nut (5) is threaded over the external threads of valve body (2) it tightens and compresses seal (12) between valve body lip 14 and cylinder end (10) allowing a sufficient seal to retain compressed gasses. A similar valve body is inserted through cap circular aperture (24) with valve body first end (4) exterior to cylinder (15) and valve body second end (6) inside cylinder (15) when cap (20) is inserted into cylinder (15) and resting on rolled lip (28). Fig. W illustrates cap (20) inserted through open cylinder end (19) with valve body (2) in proper position through circular cap aperture (24). Fig. W also illustrates an alternative crimping method wherein a portion of the cap wall (23) is expanded into lip (29) such that lip (29) applies pressure under rolled lip (18). This, in turn causes partially rolled flange 26 to seat on the upper surface of rolled lip (18) causing seal (25) to be compressed thus sealing the cylinder. Both illustrated crimping method may be used independently or in conjunction.

New Claims

1. Apparatus for taking discrete samples from a continuous flow path of gas or fluid characterized by:

(a) a first flow-through sample container (5),

(b) at least a second flow-through sample container (12), coupled in parallel to the first flow-through sample container,

(c) valve means having at least a first operating position, directing flow through the first flow-through sample container (5) and closing off flow to the second container (12), and at least a second operating position, directing flow through the second flow-through sample container (12) and closing off flow to the first container (5),

wherein said first sample container (5) is detachable from the system, for taking a sample when the valve means (50) is in its second operating position and wherein said second sample container (12) is detachable from the system for taking a sample when the valve means (50) is in its first operating position.

2. Apparatus according to Claim 1 characterized in that said valve means comprise:

(a) a first flow directing valve (50) upstream of said parallel first and second sample containers (5, 12) and

(b) a second flow directing valve (57) downstream of said parallel first and second sample containers (5, 12).

3. Apparatus according to Claim 2, characterized in that said first and second flow-directing valves are three-way valves.

4. Apparatus according to Claim 1 or 2, characterized in that each of said flow-through sample containers (5,12) is coupled between a fixed chuck (4, 13)

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and a spring-loaded chuck (6, 11), which can be retracted against the bias of its spring to permit insertion of the sample container in the flow path and then be released whereupon the spring returns the chuck to an extended position for connecting the flow-through sample container securely in the flow path.

5. Apparatus according to Claim 4, characterised in that it comprises a frame (1) having a longitudinal planar segment (40) and first and second end panels (43 and 45 respectively) which extend at rightangles from the respective ends of said longitudinal planar segment (40) and which are provided with apertures (44, 46) for mounting the fixed and spring-loaded chucks (4,13,6,11).

6. Apparatus according to Claim 4, characterized in that one or more of said fixed chucks (4, 13) or spring-loaded chucks (6, 11) has: (a) an annular body (61, 117) with a central bore having a first central bore section (64) and a second central bore section (65) of larger diameter than the first central bore section (64), thereby forming a seat (66), which has a fluid passage aperture (70) extending through said seat into the first central bore section (64), (b) a plunger depressor (67) having a finger member (68) and a transverse member (69) and resting within said second central bore section (65) on said seat (66), (c) a flexible washer (71) having a central opening of larger diameter than said finger member (68), which extends thereinto, said fluid passage aperture (70) and said transverse member (69) being disposed to permit fluid to flow through the flexible washer (71), past the transverse member (69) into the fluid passage aperture (70) and into the central bore section (64).

7. Apparatus according to one of the preceding claims, characterized in that said first and second flow-through sample containers (5,12) each comprise: an annular chamber (5) having two annular chamber ends (73 and 74), at least one end cap (75) having a first end cap interior, an end cap exterior and an

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end cap aperture, said at least one end cap (75) being demountably attached to one of said chamber ends, within which an end cap valve assembly (76) is disposed through said end cap central aperture.

8. Apparatus according to Claim 7 characterized in that said cap valve assembly (76) is retained within said annular chamber end by a swaged edge (106).

9. Apparatus according to Claim 8, characterized in that said swaged edge has opposing notches whereby the end cap valve assembly may be inserted within said annular chamber end (73 or 74).

10. Apparatus according to Claim 7, characterized in that the end cap valve assembly is retained within said annular chamber end by a plurality of dimples.

11. Apparatus according to one of Claims 7-10, characterized in that each of said annular chamber ends (73 and 74) is provided with an end cap valve assembly (76).

12. Apparatus according to one of Claims 7-11, characterized in that said end cap valve assembly comprises: (a) a first end cap valve body having a transverse base (78) and a stem (79), (b) an annular rubber ring disposed over the valve body and in contact with the transverse base (78), (c) a rigid washer (112) in contact with the rubber ring, (d) a compressor nut (113) in contact with the washer (112) and threaded on the stem (79), said compressor nut, when tightened, pressing and laterally expanding the annular rubber ring (111) to seal against the interior of the annular chamber end, (e) a retaining nut (113A) threaded on said stem (79) in contact with the end cap exterior and (f) a plunger activated valve.

13. Apparatus according to Claim 12, characterized in that the plunger activated valve has an externally threaded valve body (86) with a central cavity (90), containing a plunger (87) surrounded by supports with through holes (93, 98, 101) for passage of fluid.

14. Apparatus according to Claim 13, characterized by a spring (89) disposed between one of said supports and a spring stop (115) solidly mounted on the plunger (87).

15. Apparatus according to Claim 4, characterized in that the transverse member (69) is rectangular in shape, the length of which being greater than the diameter of the central opening of the flexible washer (71), the width of the transverse member (69) being smaller than said diameter, whereby fluid may pass through said the flexible washer and past the transverse member (69).

16. Apparatus according to Claim 2 characterized in that said first and second flow directing valves (50, 57) are pressure monitored.

17. Sample extraction assembly for extracting a fluid or gas from the first or second sample container of Claim 1 when removed from the apparatus of Claim 1, characterized in that the sample extraction assembly comprises a coupler (15) which can be coupled to the sample container (5 or 12), a hollow stem (31) slidable in a central longitudinal bore (18) in said coupler, to open the end cap valve assembly (76) as recited in Claim 7 and sealingly conduct fluid from said valve assembly through the hollow stem (31) to septum (34), which can be penetrated by an extraction needle for extraction of the fluid.

18. Extension rod pressurizer pressurizing the first or second sample container of Claim 1 prior to extraction of the fluid, comprising an internally threaded tube, one end of which can be screwed onto the end cap valve assembly (76),

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and a bolt which can be screwed into the other end of said internally threaded tube to trap and compress air and thereby pressurize the sample container.

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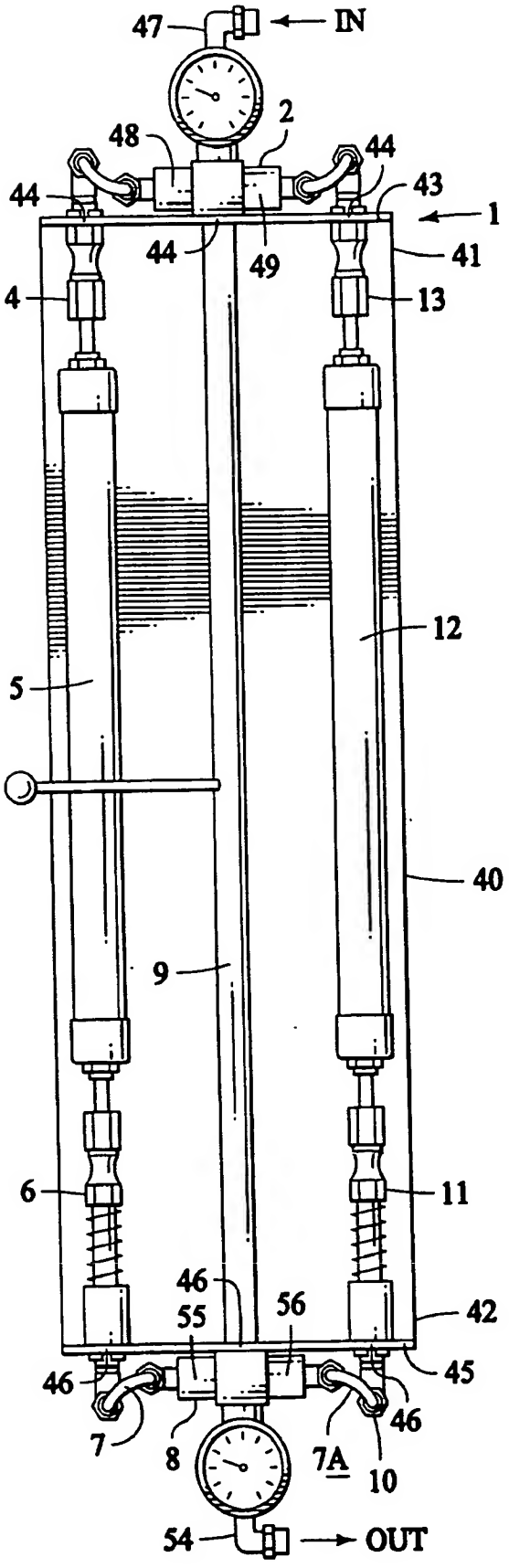

FIG.1

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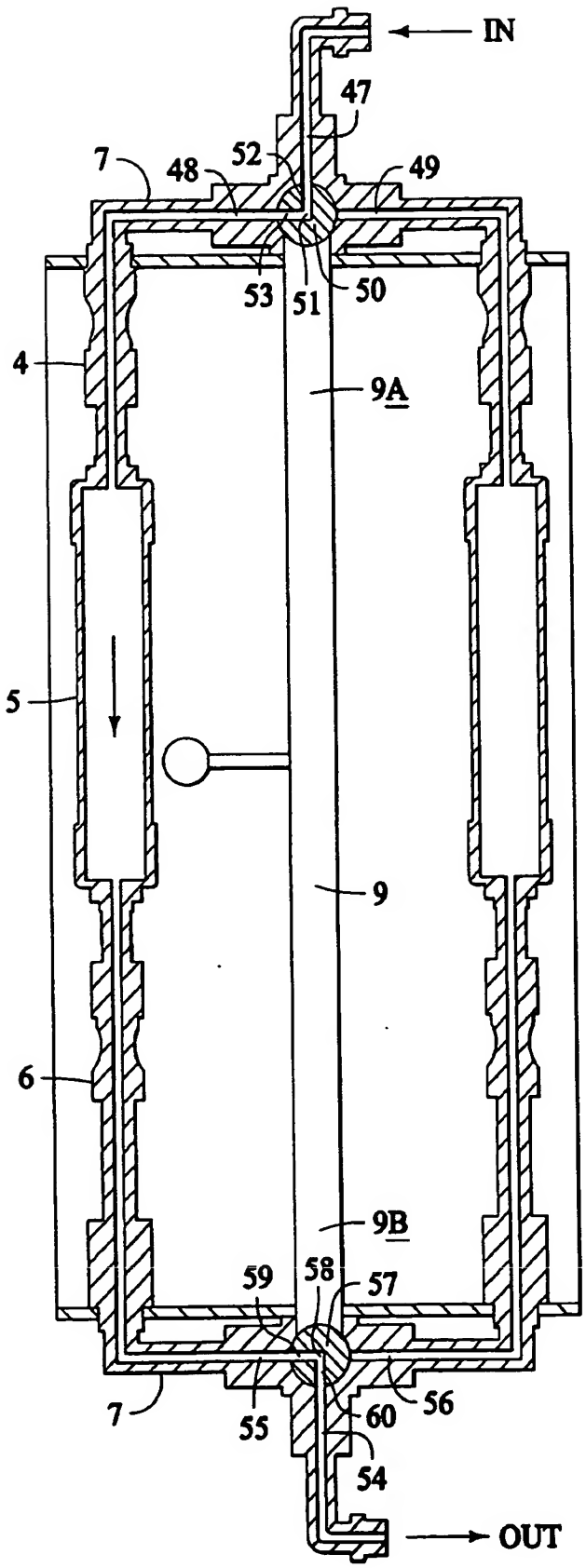

FIG.2

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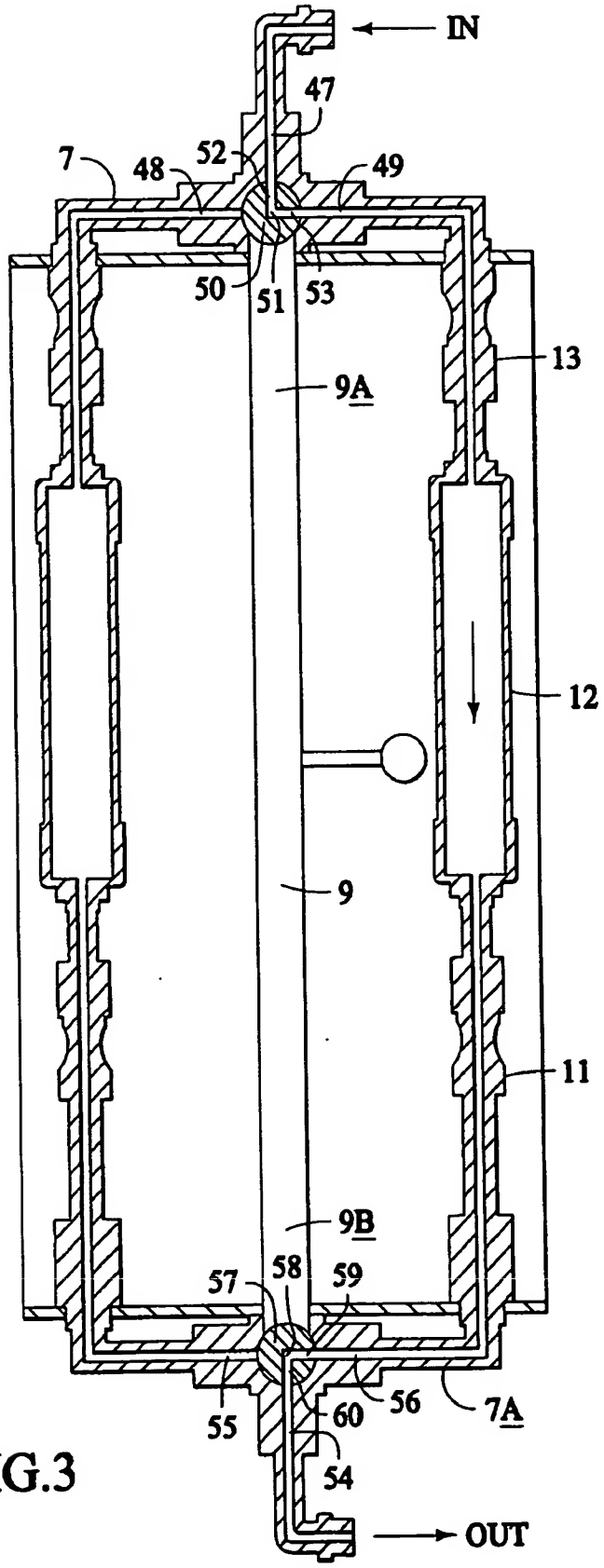

FIG.3

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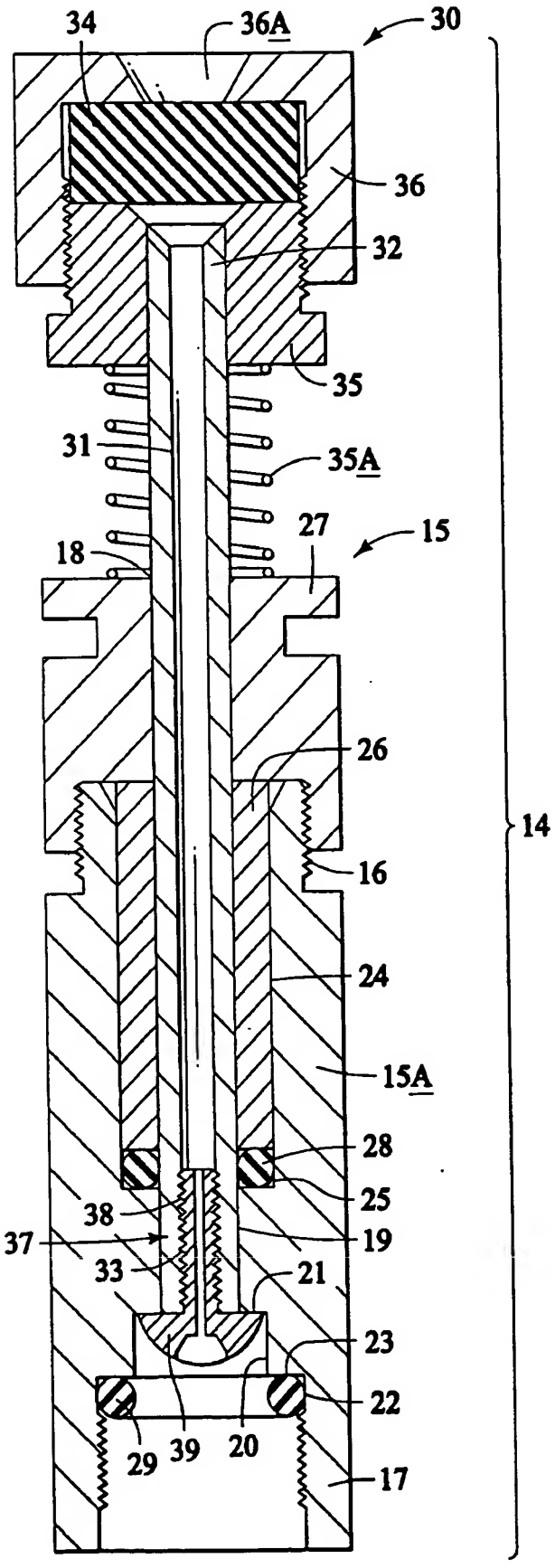

FIG.4

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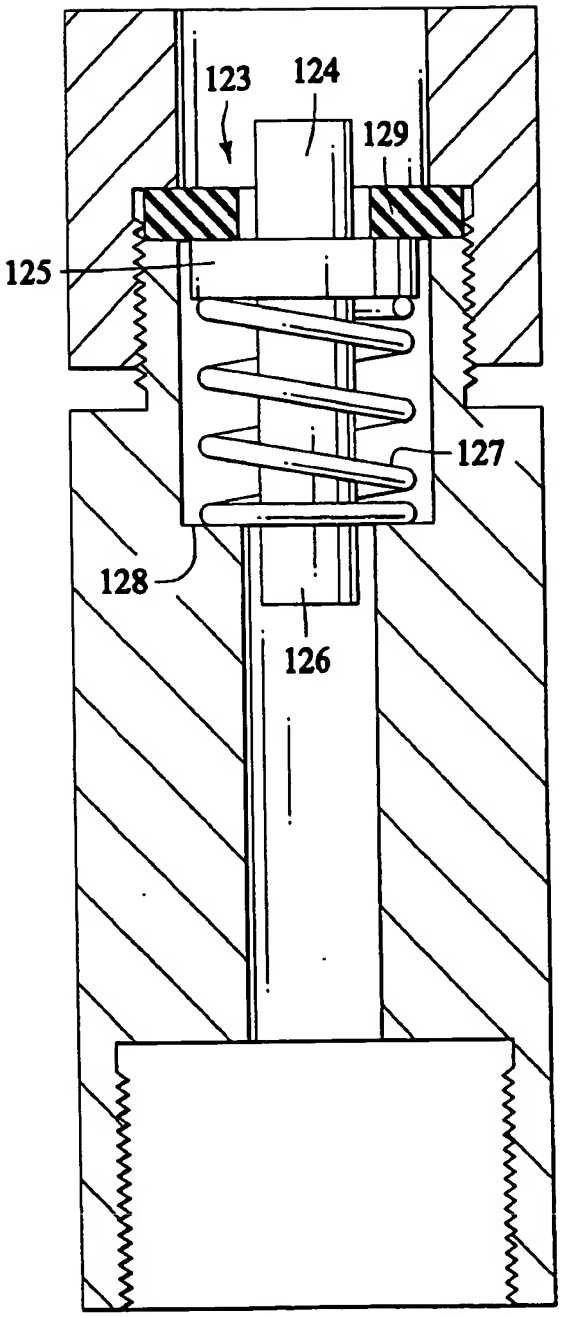

FIG.5

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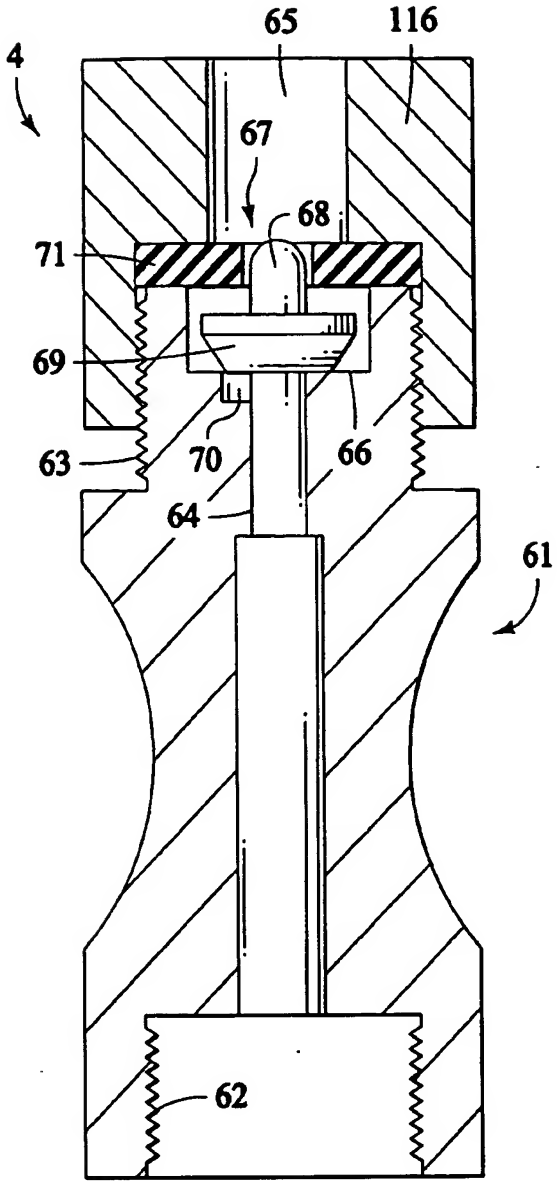

FIG.6

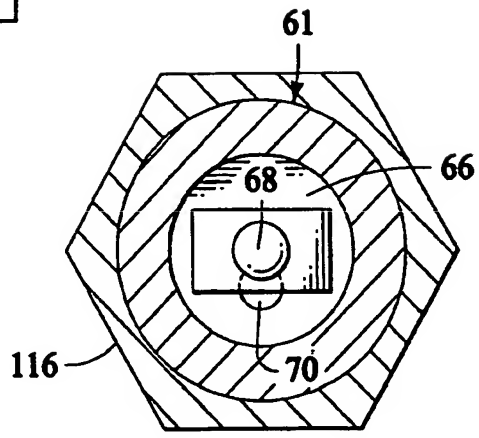

FIG.7

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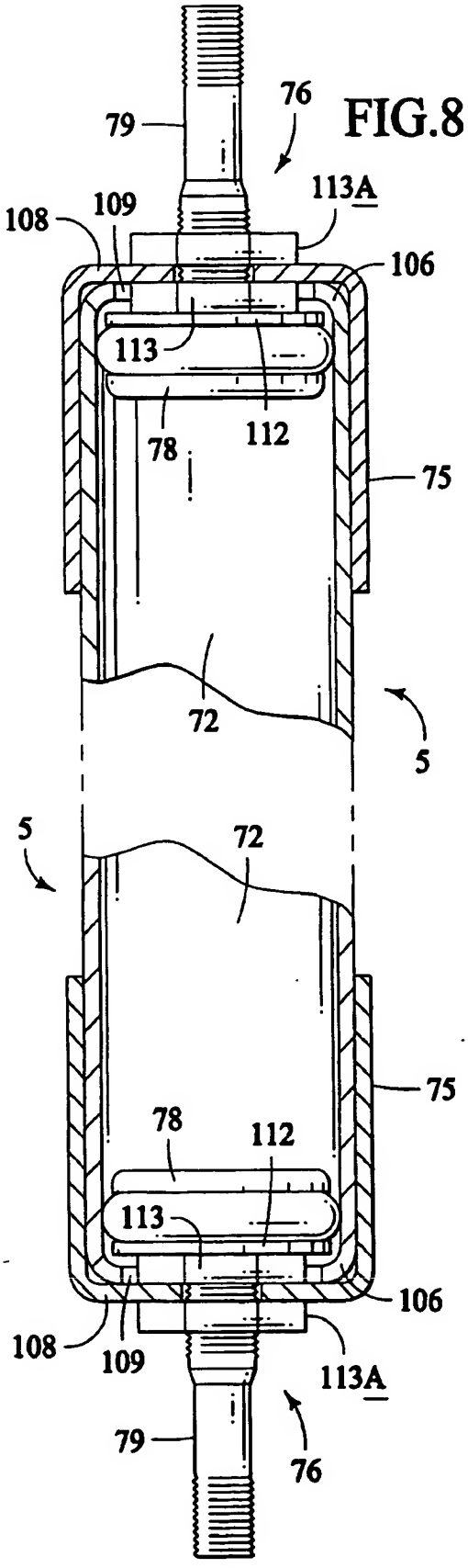

FIG.8

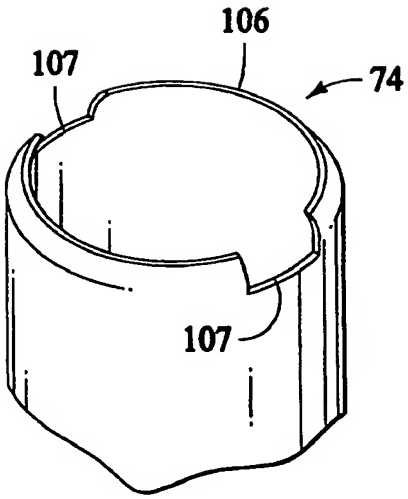

FIG.9

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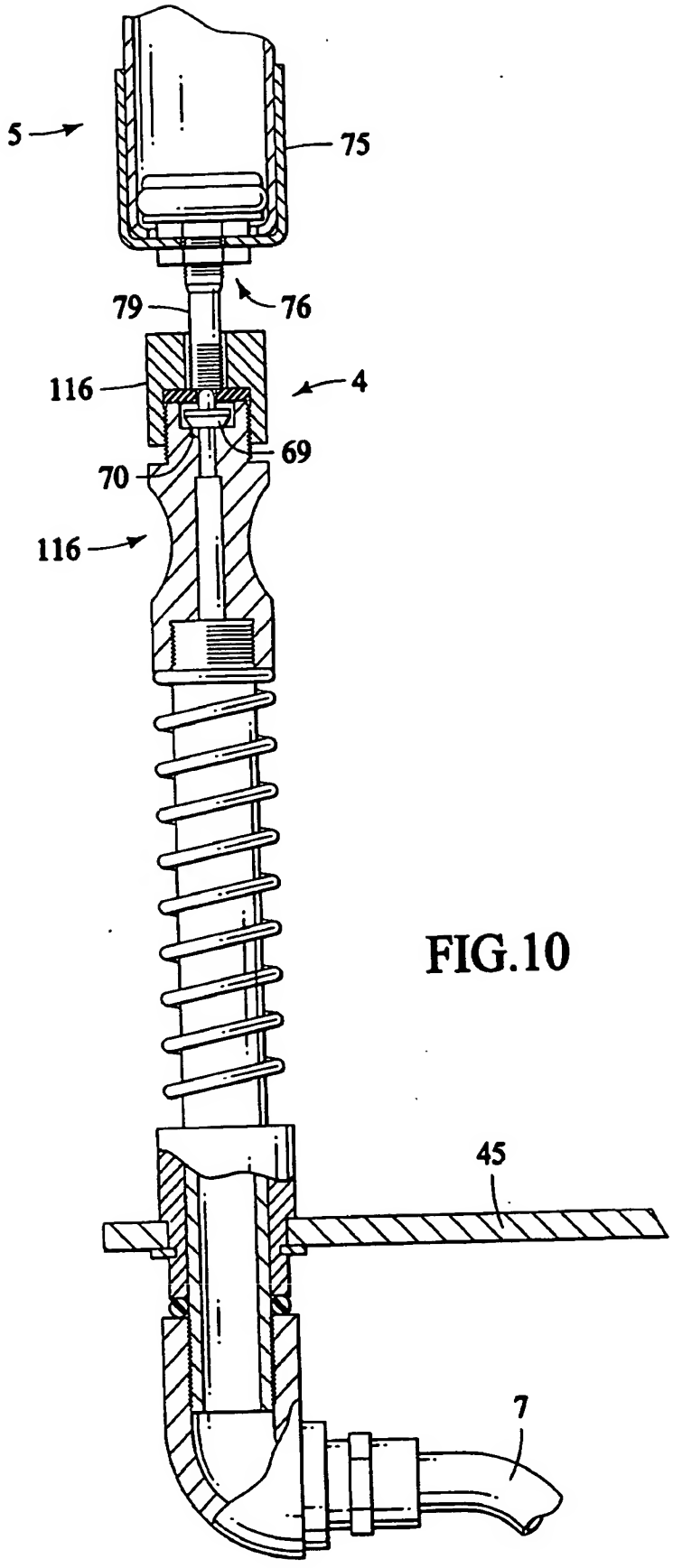

FIG.10

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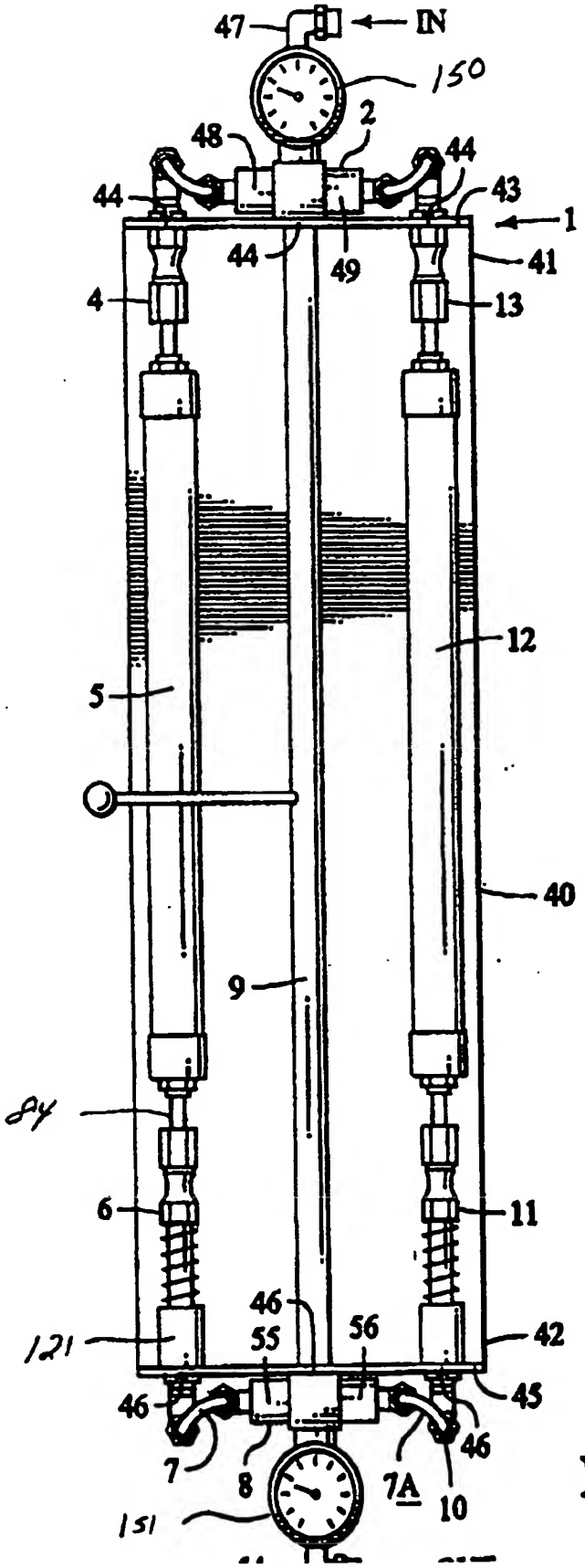

FIG.1

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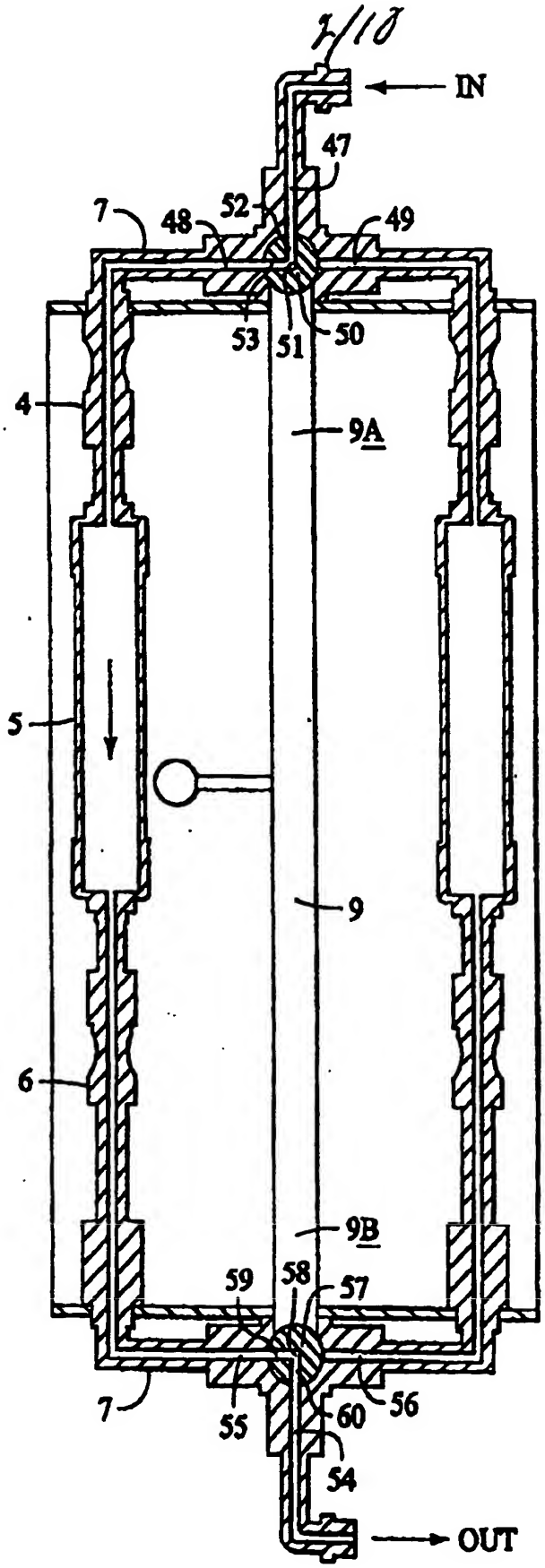

FIG.2

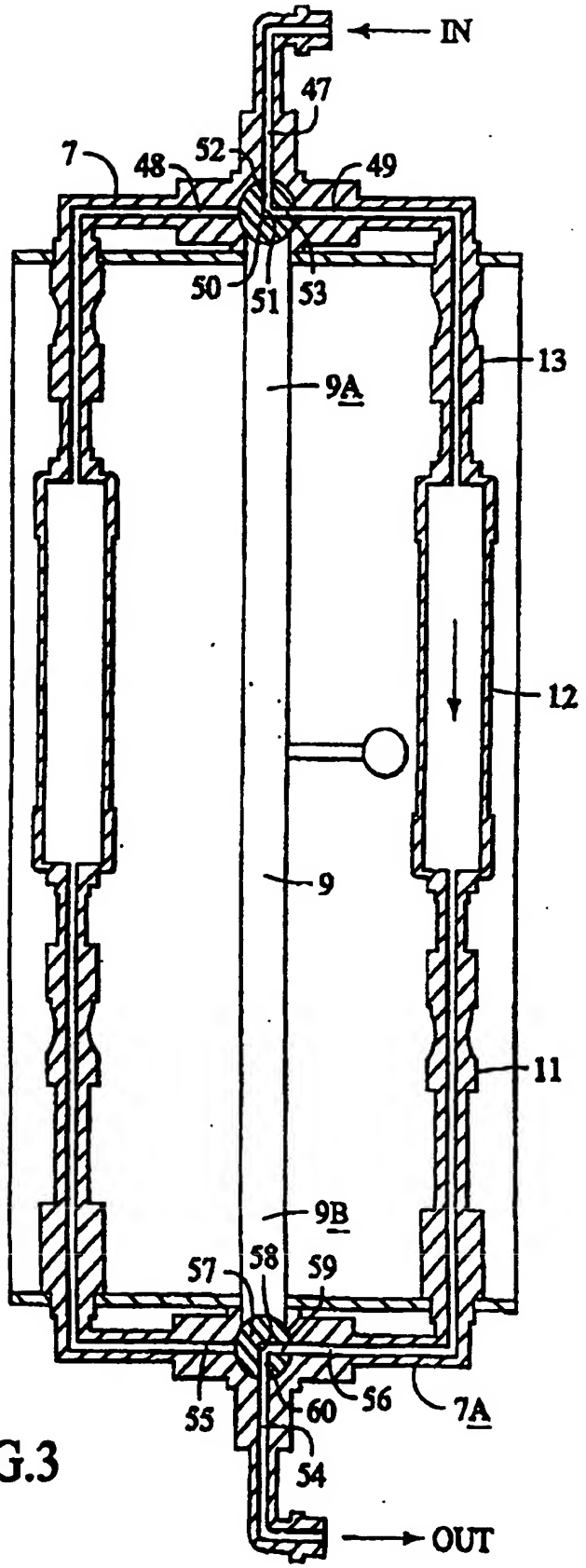

FIG.3

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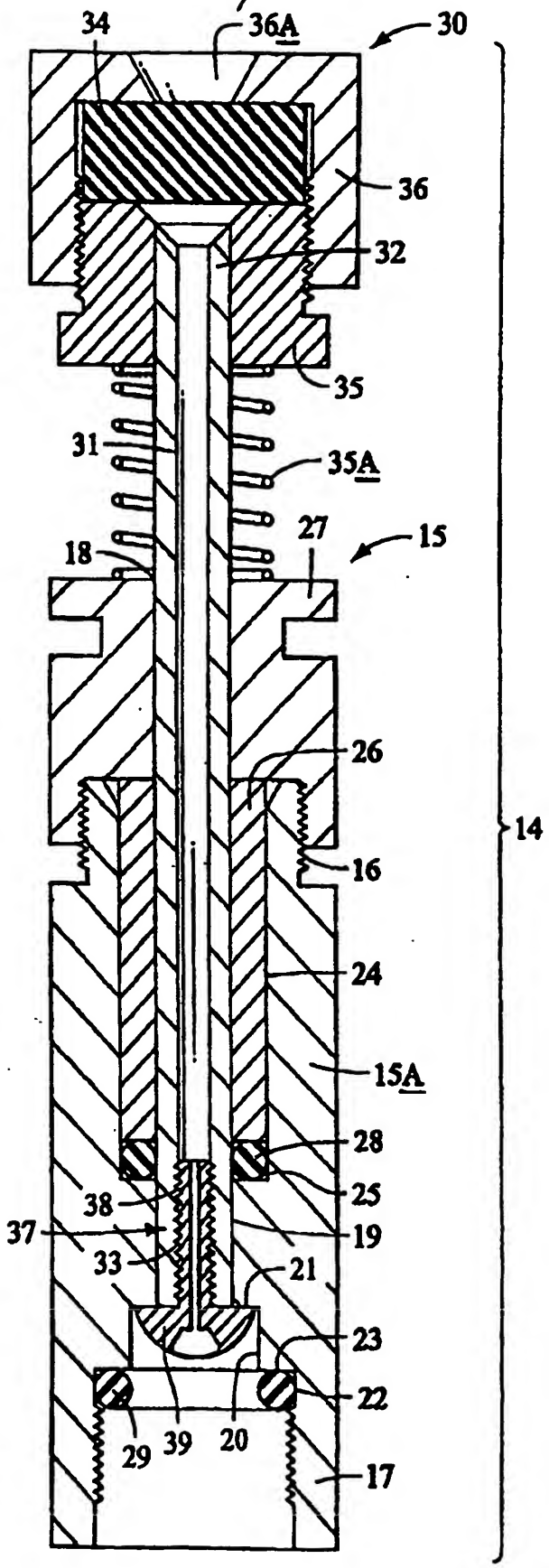

FIG.4

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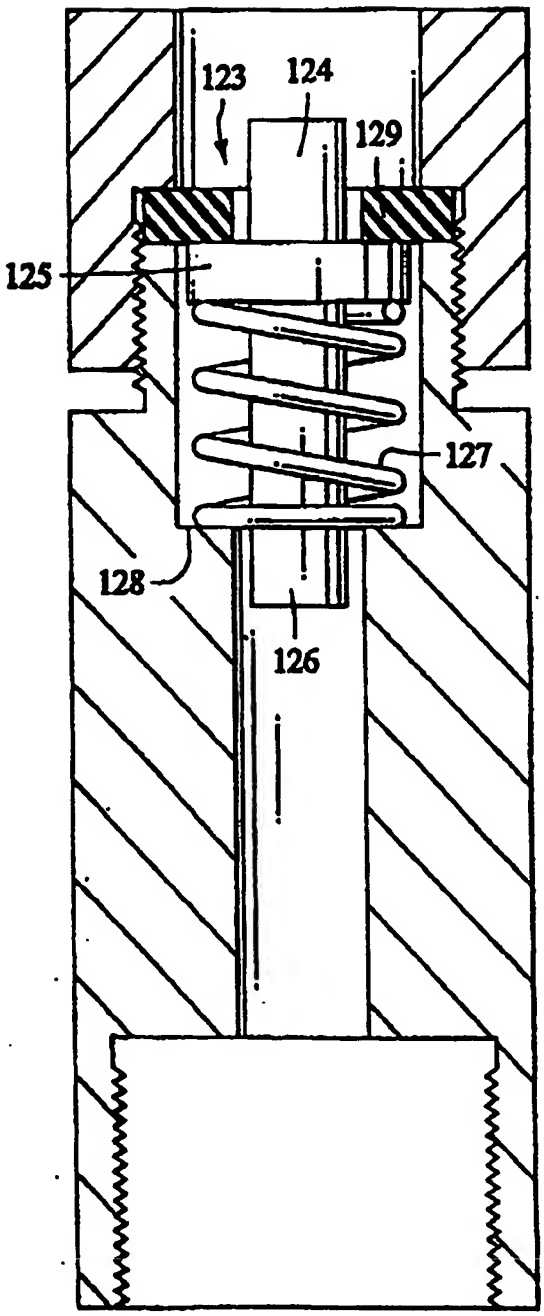


FIG.5

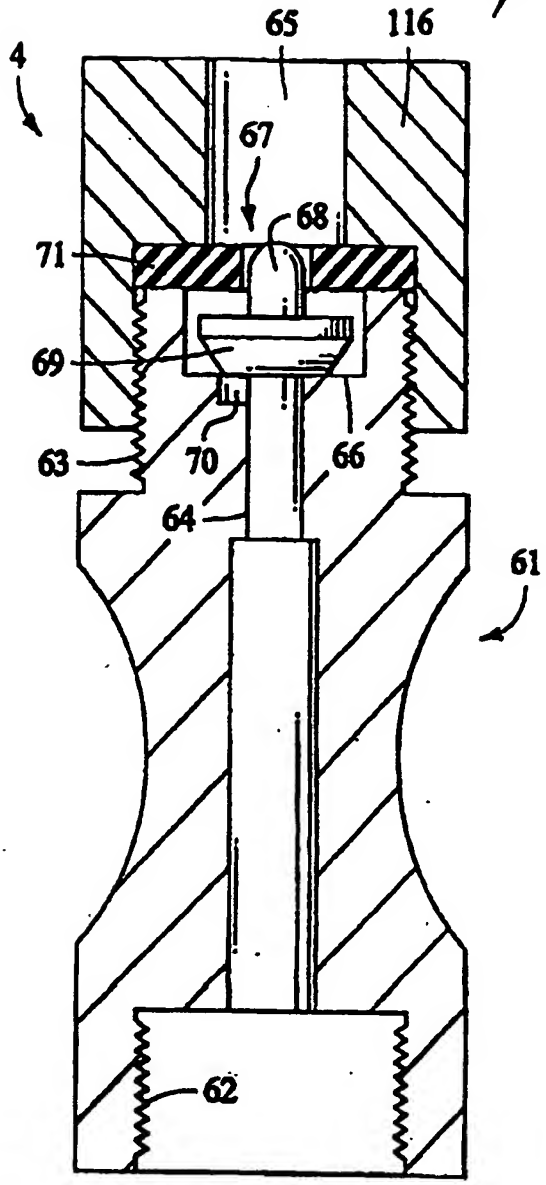


FIG.6

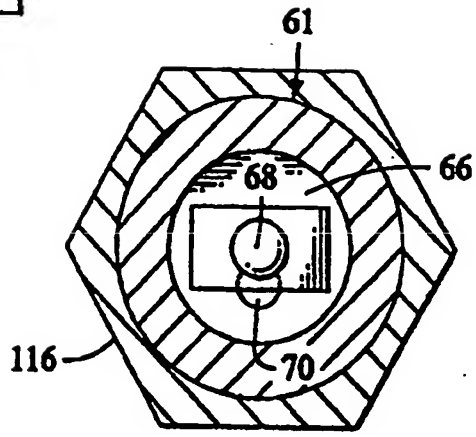
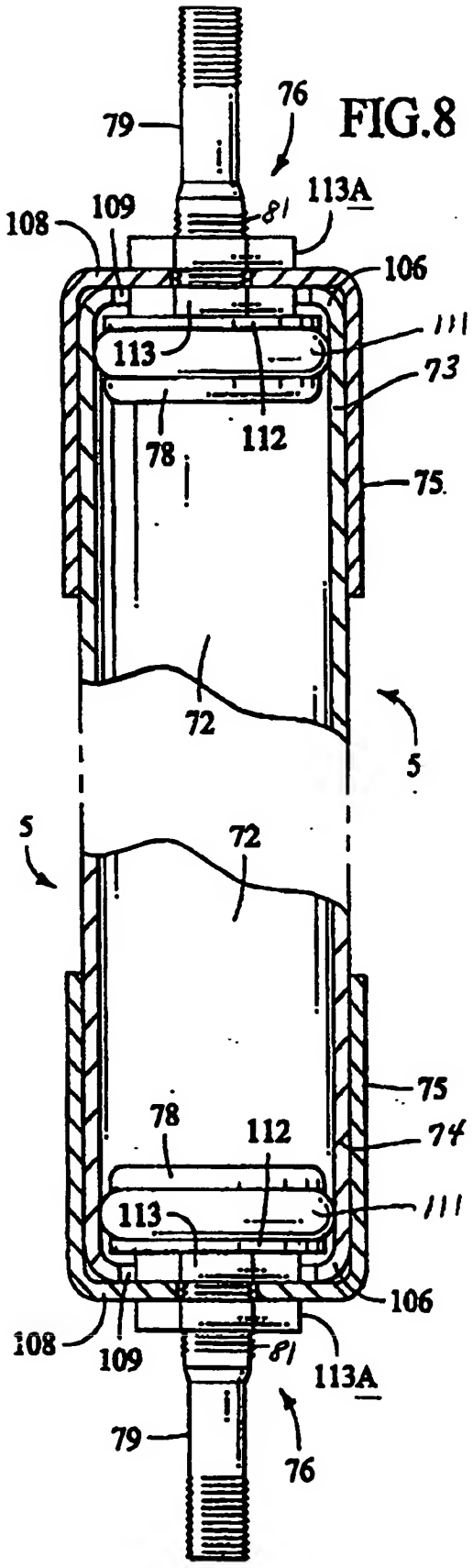


FIG.7

FIG.8



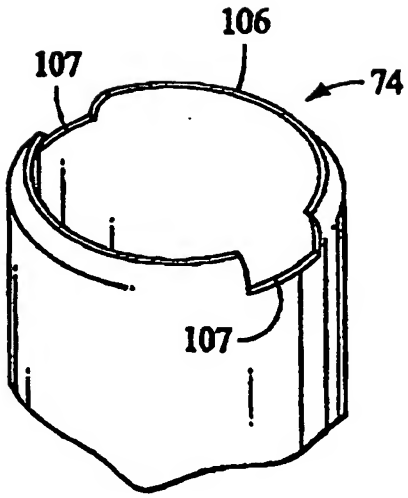


FIG.9

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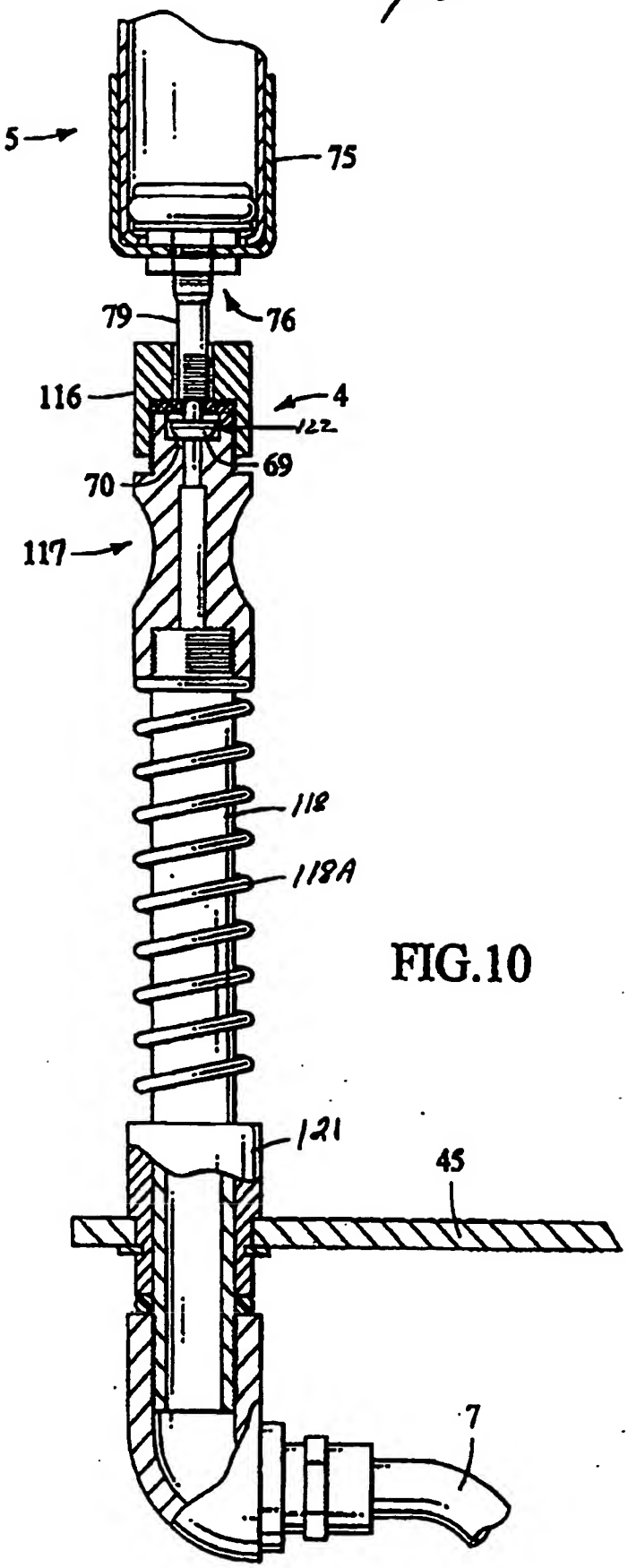

FIG.10

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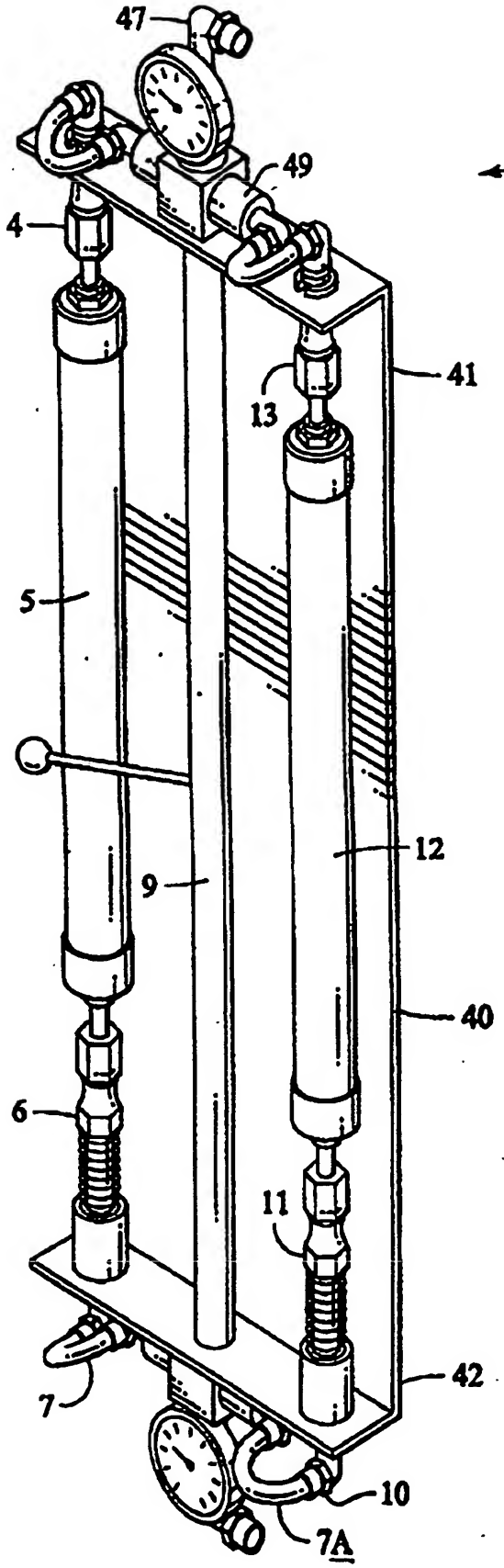

FIG.11

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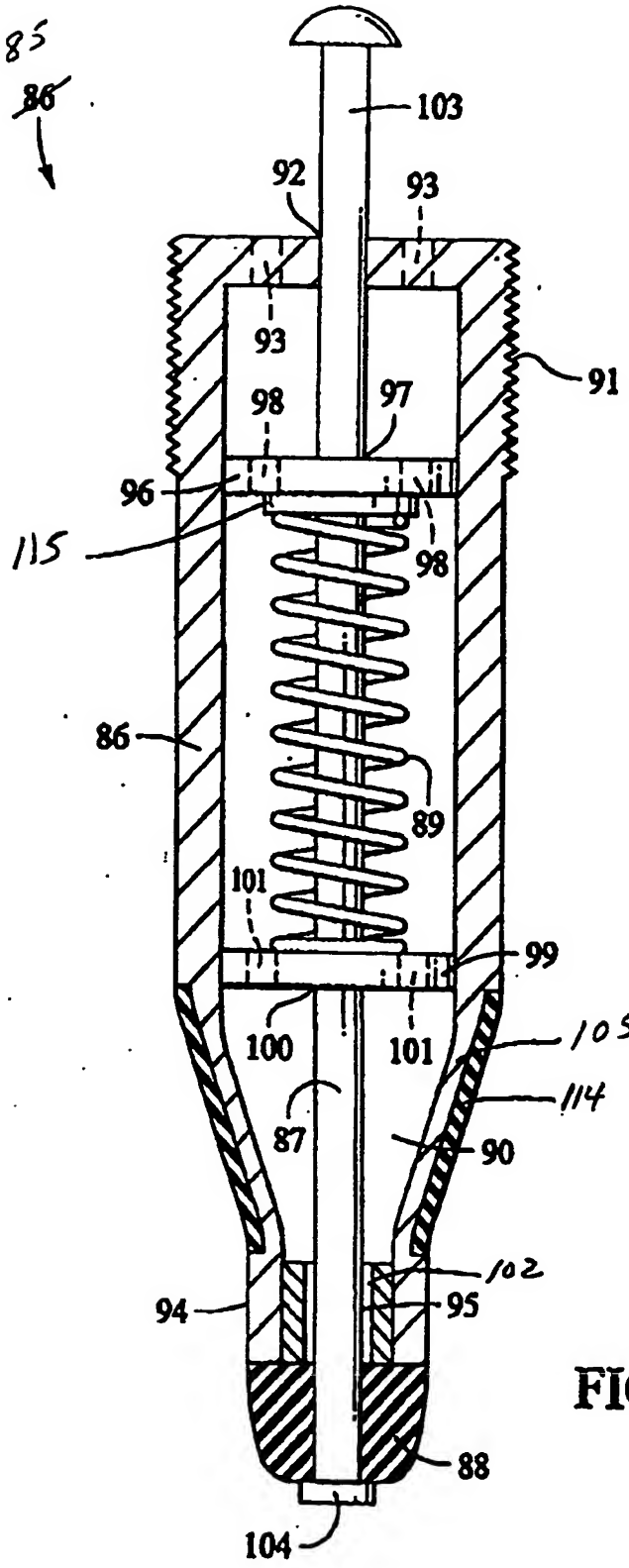

FIG.12

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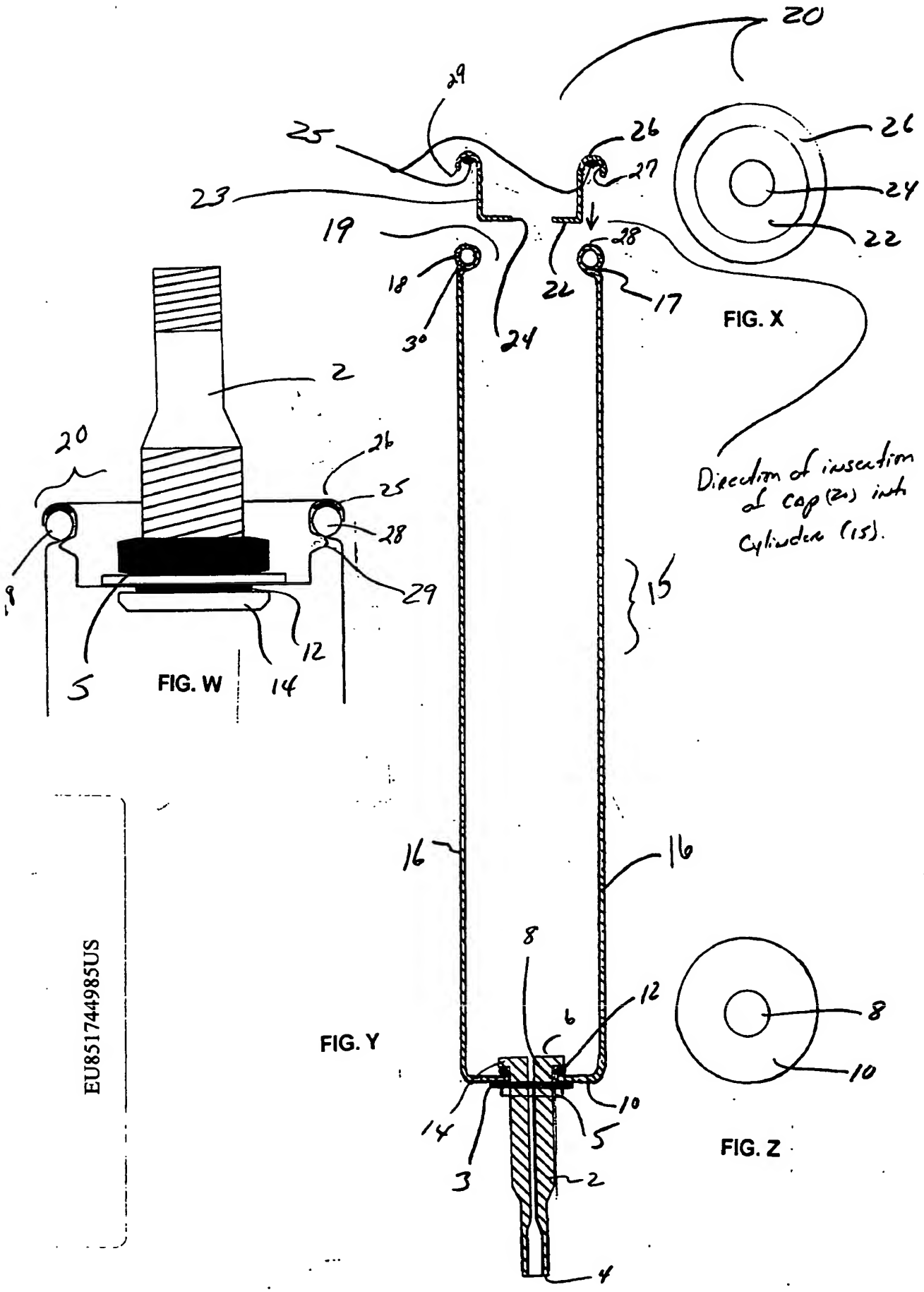

FIG. X

FIG. W

FIG. Y

FIG. Z

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☑ Declaration Submitted With Initial Filing ÑÎ ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	Pressurized Isotube
First Named Inventor	Coleman, Dennis
COMPLETE IF KNOWN	
Application Number	
Filing Date	11/12/03
Art Unit	
Examiner Name	

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Pressurized Gas Sampling Tube

(Title of the Invention)

the specification of which

☑ is attached hereto

ÑÎ

☐ was filed on (MM/DD/YYYY) ☐ as United States Application Number or PCT International Application Number ☐ and was amended on (MM/DD/YYYY) ☐ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? Yes	No
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

This collection of information is required by 3ɛ Ëd ðŸð115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Direct all correspondence to: ☐ Customer Number: _____ *OR* ☑ Correspondence address below

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United States	217 352 4343	217 352 4344

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NAME OF SOLE OR FIRST INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
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NAME OF SECOND INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
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Inventor's Signature: Todd M. Cole — Date: 11/12/03

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☐ Additional inventors or a legal representative are being named on the _____ supplemental sheet(s) PTO/SB/02A or 02LR attached hereto.

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Document made available under the Patent Cooperation Treaty (PCT)

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International filing date: 12 November 2004 (12.11.2004)

Document type: Certified copy of priority document

Document details: Country/Office: US
Number: 60/519,410
Filing date: 12 November 2003 (12.11.2003)

Date of receipt at the International Bureau: 10 January 2005 (10.01.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

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